JULY • 1955
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# ELECTRICAL CONSTRUCTION AND MAINTENANCE

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**Joseph H. Previty of Philadelphia named president of National Industrial Service Association at Los Angeles convention.**

**Unique construction features of new M. I. T. auditorium building require novel electrical installation methods.** **page 69**

**SOUND SYSTEMS** **are a booming business for electrical contractors who know components and methods. A comprehensive editorial report on materials and techniques begins on page 82**

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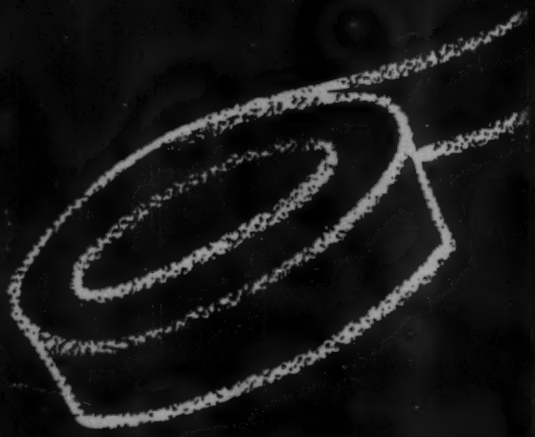

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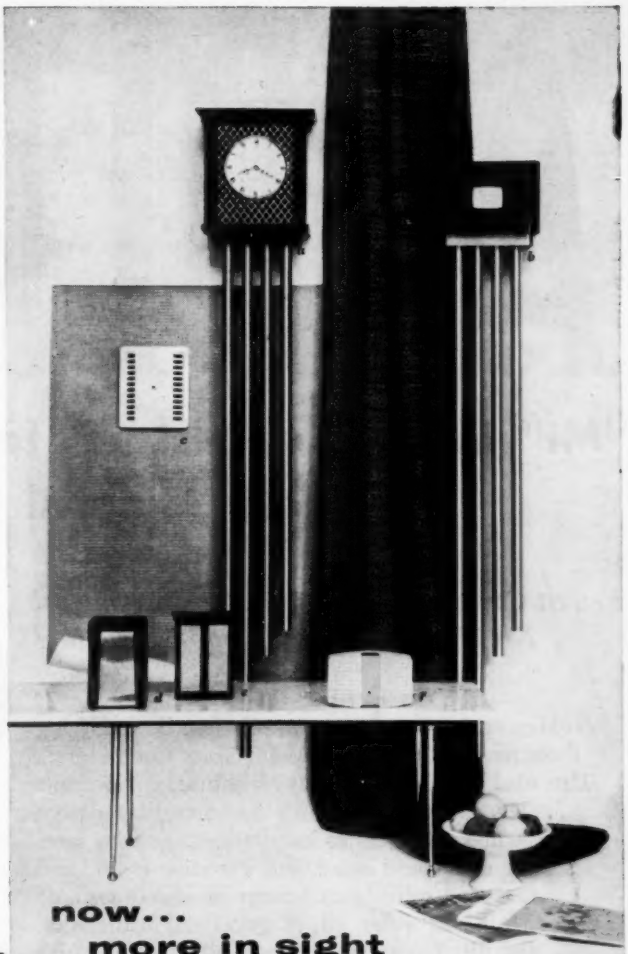

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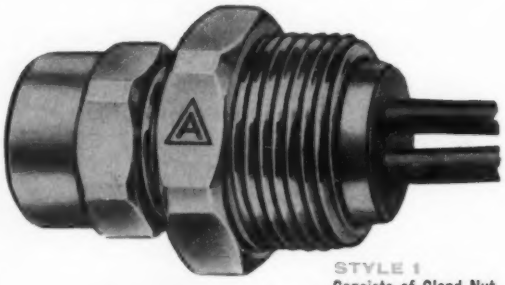

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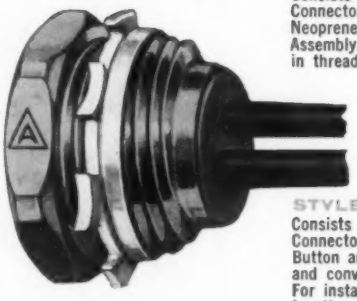

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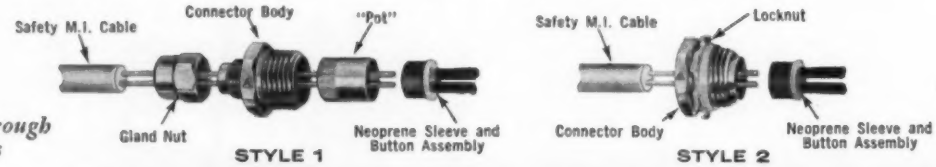


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with which is consolidated Electrical Contracting, The Electragist and Electrical Record — Established 1901

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

*54th Year* JULY • 1955



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# —Sidelights—

**ALL ELECTRIC**—Near Fullerton, Calif., a development of 431 homes Linda-Lyle Estates, will form an all-electric community. Packaged air-to-air heat pumps provide heating and cooling in each home. All-electric kitchens include a built-in oven and range, dishwasher, garbage disposer and electric water heater. Ventilating hoods over ranges have electric fans and lighting is controlled by low-voltage remote control switches. All electric equipment is included in the purchase price of the house available in five models from $16,500 to $21,500.

**SOUND SYSTEMS**—Application of sound systems—paging, music reproduction and signals—is growing steadily and rapidly throughout the country. Just about any commercial, industrial or residential area can benefit from some form of sound system. But where do you fit into the picture?

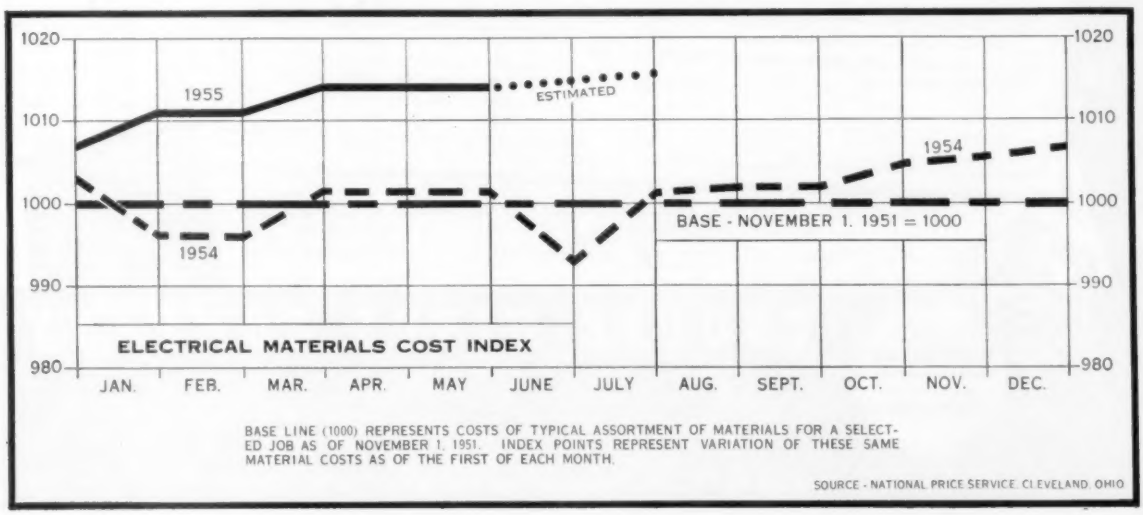
One of the strangest things about the whole subject is that the practical electrical man has more or less steered clear of sound systems. For one reason or another, he came to look on sound work as a tricky electronic proposition. Right or wrong, he left the work solely to the hard core of sound specialists who have so ably handled the work throughout the country. But the growth and potential of sound system application can hardly be met and satisfied by the relatively small number of sound specialists. The vast volume of work to be done in this field now requires the veritable army of skilled men in the electrical construction and maintenance industry.

To meet the requirements of the majority of sound applications, manufacturers of sound equipment have standardized and unitized their equipment. As a result, sound work can be handled on a "black box" basis—"connect microphone here, speakers here; plug-in and operate."

Following this approach to the subject, Sound Systems—Part 1, the first of a series of three articles on paging and music systems, begins on page 82. This is a specially prepared series for our readers and represents a unique contribution to sound literature. Continued coverage of the whole field of sound will follow this series.

**METHODS**—Wiring methods frequently are dictated by features of design or types of construction. This was illustrated in last June's report on "Lift Slab Wiring Techniques", and it is again emphasized at the new M.I.T. auditorium in Cambridge, where the prevalence of curved surfaces, continuous expansion joints and cantilever construction features necessitated countless deviations from normal electrical installation procedures. Many of these techniques were developed by the Hixon Electric Company of Boston and, since the cone-shaped structure is reminiscent in appearance of a Colonial tri-cornered headgear, we call the story beginning on page 69 a "Wiring Revolution . . . in a Cocked Hat".

**SCHOOL LIGHTING**—One of the major items in every local tax budget is the school tax, which goes for building, maintaining, and operating the local school system. Part of this school tax goes for lighting, either in new buildings or for relighting old ones. Thus every taxpayer wants to know more about school lighting—why its needed, how much light is required, what it costs, and how one system compares with another. R. L. Zahour, Westinghouse illuminating engineer, has answered these and similar questions in laymen's language, based on sound technical analysis, in a feature article on "Economics of Classroom Lighting". This article can be shown to school board officials, parent-teacher groups, or even taxpayers who are interested, as well as used by architects, consulting engineers, electrical contractors and others, to help them in their selection of the best school lighting system possible for their specific local lighting problems. This article begins on page 77.




BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.

SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO

## What to look for when buying

# SPORTS FLOODLIGHTS

Some floodlights give you more for your money than others. Make sure you get *all* the time-tested features that mean easier installation . . . less service trouble . . . longer operation . . . greater economy over the years. Before buying any floodlight, ask yourself these questions . . .

• Cut out and save this technical guide

| FEATURES | CROUSE-HINDS TYPE FLA | Mfr. A | Mfr. B | Mfr. C | Mfr. D | Mfr. E | Mfr. F |
|---|---|---|---|---|---|---|---|
| 1. Does it have a backdoor for easier lamp replacement and cleaning? | Yes | Yes | No | Yes | Yes | Yes | No |
| 2. Is there a sight on the axis for more accurate aiming? | Yes | No | No | Yes | No | Yes | No |
| 3. Are the door catches adequate for permanent weather-tightness? | Yes | Yes | Yes | No | Yes | Yes | No |
| 4. Is the floodlight wired, eliminating additional costs? | Yes | Yes | Yes | No | Yes | Yes | No |
| 5. Is the socket shell plated to prevent corrosion and lamps "freezing" in? | Yes | Yes | Yes | Yes | No | No | Yes |
| 6. What is the socket temperature? (UL maximum safe operating temperature 200°C) | 185°C | 230°C | 226°C | 227°C | 269°C | 211°C | 259°C |
| 7. What is the cable temperature? (to minimize insulation deterioration) | 135°C | 181°C | 202°C | 150°C | 231°C | 173°C | 195°C |
| 8. Is the lens heat-tempered to prevent breakage? | Yes | Yes | Yes | Yes | Yes | Yes | No |
| 9. Will the Floodlight withstand the UL rain test? | Yes | Yes | Yes | Yes | No | No | No |
| 10. Are the gaskets adequate for permanent weather-tightness? | Yes | Yes | No | Yes | Yes | No | No |
| 11. Is the floodlight rigidly constructed for longer life and accurate aiming? | Yes | Yes | Yes | No | Yes | Yes | No |
| 12. Can you rotate the wire entrance to simplify wiring? | Yes | No | No | No | No | No | No |
| 13. How many beam spreads are available and what are their efficiencies? — 14° . . . | 45.3% | N.M.† | N.M. | N.M. | N.M. | N.M. | N.M. |
| — 20° . . . | 44.9% | 43.5% | 43.8% | 41.2% | N.P.‡ | N.P. | N.M. |
| — 35° . . . | 48.6% | 50.3% | 49.1% | 50.5% | 45.2% | N.P. | 38.6% |
| — 50° . . . | 50.2% | N.M. | N.M. | N.P. | N.M. | N.P. | N.M. |
| — 80° . . . | 57.8% | 56.3% | 58.4% | N.P. | N.P. | N.P. | 60.3% |

†N.M. Not made by this company. ‡N.P. Not published.

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# Washington Report

**Business outlook is for a record year** as the last half of 1955 maintains its boom pace in most industries, in the opinion of most Washington economic experts. Any declines over the next six months which may occur in such seasonal industries as autos, or possibly home building, will in all probability be more than offset by continued growth in other industries.

Some reasons why 1955 will be a record year: Gross National Product is now (midyear) at $375 billion annual rate, compared with $364 billion peak in 1953; personal income hit $295.6 billion annual rate in April, up $11.2 billion over a year earlier; industrial production in May was at annual rate of 138% of the 1947-49 average, compared with 124% a year earlier; cost-of-living index was 114.2 in April, compared with peak of 115.2 in July 1954; unemployment was down to about 2.5 million at midyear while employment is currently increasing in most areas; steel production is booming along at new records; new building construction activity is at the highest rate in history with no signs of letting up or slowing down materially; electric power output is at a record rate, averaging about 15% ahead of a year earlier; and auto production has maintained higher levels throughout 1955 than had been predicted or expected.

**Rising prices are predicted** for the months ahead, as labor costs and raw materials prices increase. The auto industry-labor union settlement, on GAW and higher wages, touched off the spiral. Big question is: Will competition prevent inflation? Administration economists think so, but fear stiffer competition will create new hardships for small business.

**Steel production set a new milepost in May** when 10,331,000 tons of raw steel flowed from the nation's furnaces. This topped the previous record of 10,168,000 tons produced in March 1953, and was 2,858,000 tons above May of last year. Production normally drops in Summer, due to hot weather and for mill maintenance but, barring strikes which are not expected, the cutback this Summer is expected to be slight. With the order backlog still growing, steel output is predicted for remainder of this year at near-capacity rate. 1955 capacity is figured at 125,828,310 net tons. An industry spokesman testifying before a Congressional subcommittee recently predicted that steel demand would climb to 200 million tons annually "in the not too distant future." Plant expansion now under way in the steel industry will add about 10 million tons annually by 1958.

**New building construction hit a new May record** this year when work put in place totaled $3.5 billion. This was $397 million above total for May last year, and $276 million over the April 1955 total. Private financing accounted for $2.5 billion, while $1 billion was public fund work.

**Home building forged ahead** at annual rate of over 1.3 million units during first half of this year, near 1950's record pace of 1.4 million units. Commerce Dept. credits five factors for this sustained boom: easy credit, ample supply of mortgage money, rising incomes, an increasing and shifting population, and a general desire for bigger and better homes.

Congress has been plugging for even more public housing than Eisenhower's recommended 35,000 units a year, in spite of the diminishing demand for such housing and the building industry's caution that home building is at an excessive rate and that there is a growing surplus in most areas.

Housing starts in May were 132,000 units, BLS reported, of which 129,500 units were financed by private funds, and 2500 units were public housing. Total for first five months of 1955 were 553,500 starts, for similar period last year, 453,000 starts, and for record-breaking 1950, 561,400 starts.

# Canadian Bank Installs Wakefield BETAS

**Beta-Lighted Royal Bank of Canada branch office is in Canada's finest new office building, NINETEEN EIGHTY SHERBROOKE WEST, Montreal**

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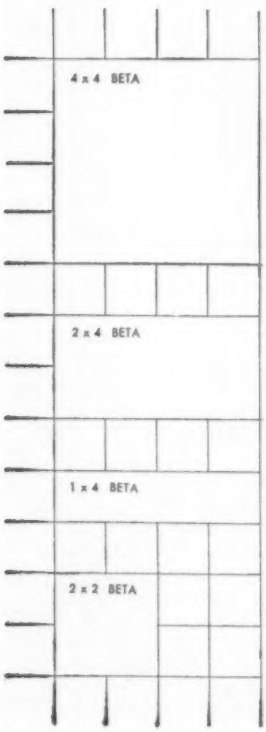


Called "the building that couldn't wait for the future", Montreal's Nineteen Eighty Sherbrooke West "was designed for a nation on the threshold of greatness". One of the occupants is the Royal Bank of Canada, which elected to establish one of its latest branches in this beautiful building.

See how beautifully Wakefield recessed Beta units light this smart interior, how readily they complement the modern design. These are the 4′x4′ size, with six 40W rapid start bi-pin lamps. Maintained footcandles: 30 to 40.

Betas also come in 1′x4′, 2′x4′ and 2′x2′ sizes. Each is a self-contained unit with a Rigid-Arch plastic diffuser whose non-specular finish does not mirror reflections from the street.

For a brochure on the Wakefield Beta, write The Wakefield Company, Vermilion, Ohio. In Canada: Wakefield Lighting Limited, London, Ontario.

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# Lagging Public Construction — A Spreading National Blight

The most recent editorial in this series dealt with the plans of American industry for expanding and modernizing its plant and equipment over the next four years. These plans call for the expenditure of $113 billion over that period. There is a good prospect that the money to carry them out will be available. If the plans are carried out, manufacturing capacity at the end of 1958 will be double that which existed at the end of World War II. And this industrial plant will be modernized.

In sharp contrast to this picture is the condition of our *public* plant and equipment — the roads, schools, water supply, health and sanitation facilities upon which industry, as well as the average family, depends. **According to a recent estimate by the Twentieth Century Fund, the people of the United States must spend almost $100 billion on new public works projects during the next five years merely to meet the minimum needs of our growing economy.**

**Other estimates by the President's Council of Economic Advisers, by state agencies and by private construction economists all show the same condition: a staggering need for public works. Yet no steps have been taken that even offer a promise of closing the gap between the public facilities we are building and the greater facilities we really need.**

How did we come to let our public facilities fall into this sorry state? Here are some of the reasons:

(1) During the years of depression and war, from 1930 to 1945, these facilities were neglected. New construction declined, and even maintenance was cut.

(2) Since the end of World War II, increased construction costs have made it difficult for communities to get the needed construction with the funds budgeted in the past for that purpose.

(3) The great postwar upsurge in population, and the spreading of our population into new areas, has created a huge demand for additional community facilities before the neglect of earlier years could be made up.

## Responsibility Divided

Now the need for more public construction has become apparent to everyone, on jammed highways and in over-crowded schools. But, unfortunately, the responsibility for doing something about this situation cannot be so clearly fixed as can the responsibility for maintaining industrial facilities. A business firm must expand its capacity when markets are growing or lose its trade position. It must modernize its plant and equipment or be undersold by more efficient competitors. In the case of public facil-

ities, there is no such competitive incentive. To be sure, a city or state may lose population and industries if its public facilities are inadequate. But such shifts are very slow to take place and difficult to relate to any specific public program, or lack of it.

Moreover, the responsibility for constructing public facilities is divided between state and local governments and federal authorities. Within each of these governmental units there are specialized bureaus or departments with varying responsibilities. This division of responsibility obviously adds an element of difficulty to the development of an adequate program of public construction.

## Breaking the Log-Jam

How can this administrative log-jam be broken and the financial difficulties overcome?

One course would be to have the federal government step in with a nation-wide new program of direct spending on public works. That would utilize the resources of the federal treasury for immediate action. But there are weighty objections to such extensive federal participation. One is that federal spending cannot be greatly enlarged without a corresponding increase in the federal control of decisions that normally have been left to local communities. Another objection is based on the fact that so long as we must maintain a large defense establishment, such an addition to federal spending means either higher taxes or a chronically unbalanced budget.

The other course is to rely primarily on local initiative, but with new and more effective federal aid to local governments. Such aid would help speed up planning and construction, and contribute toward a solution of the most burdensome financing problems, but in amounts sufficiently limited to require that most of the capital be raised locally.

## No Single Formula

No one formula can be applied to make such aid effective. The raising of funds for new schools, for example, involves problems very different from those of financing highways, or water-works, or hospitals. But it does seem clear that, in all these fields, the federal grants must be designed to stimulate more local planning and financing than has prevailed in the past. Among the new ideas that may offer such incentives are federal grants for planning and initial costs and federal guarantees of local bond issues. Such aids have been remarkably effective in the fields of slum clearance and public housing.

While the federal government clearly has a role to play, we cannot afford to postpone inauguration of an adequate public construction program while we seek a formula to apportion governmental participation that would be generally accepted as ideal. Every year about 2½ million more Americans are putting increasing pressure on a public plant already dilapidated and inadequate. The result is an increasing menace to comfort, health, education and safety. It is also an increasing menace to the effective performance of American industry.

**The appropriate public response to this situation is a driving public determination to eliminate this increasingly dangerous lag in public construction. At this juncture, the development of such a determination is basic. Nothing stands in the way of an adequate program of public construction that a determined electorate cannot remove.**

*This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.*

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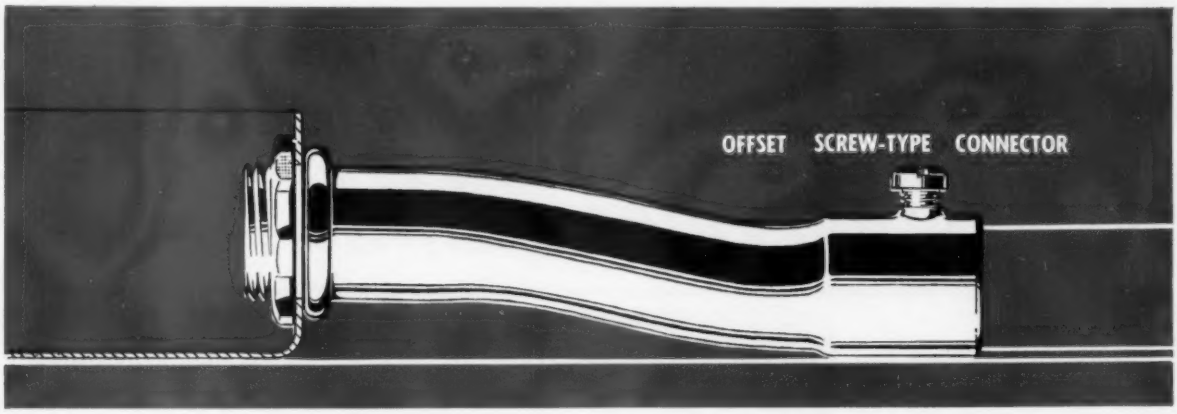


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# Tube-weld

## presents a new concept in electric fitting design!

**Bending offset connectors wastes time and money!** Tube-Weld eliminates this costly, time consuming chore with this new concept in design. Developed after careful study of electrical contractor needs – this unique fitting allows fast, economical connecting and wiring. Tube-Weld's one-piece, thin wall steel tubing means increased inside diameters. Its longer length means greater bearing support and rigidity of conduit.

You can put your confidence in Tube-Weld fittings:

- in the oversized hardened steel set screws that are *staked for permanency!*
- in the uniformly flat connector shoulders that assure perfect centering in the box.
- in the rolled instead of cut threads which have 54% greater stripping strength and 66% greater snapping strength according to an independent testing laboratory report.
- in the smooth, lustrous zinc finish and carefully beveled edges—your assurance of workmanship that is unsurpassed in the electric fitting field.

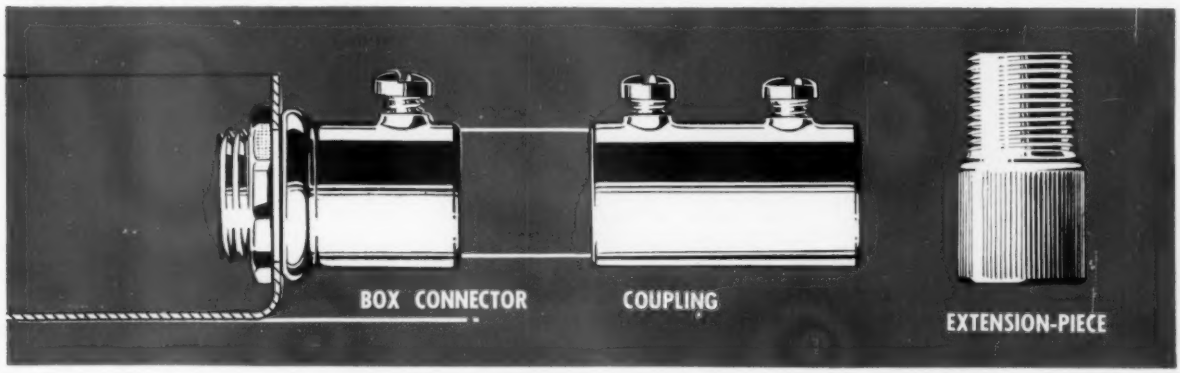
Tube-Weld fittings are available in ½", ¾" and 1" sizes. They are carefully and smartly boxed for ease in shelving and identification. For descriptive brochure and additional information, write or call: **Electric Tube Products**

**74-16 Grand Ave., Maspeth (N.Y.C.) N.Y.**
**DEfender 5-8000**

UL

## CONNECT WITH ETP FOR ECONOMY

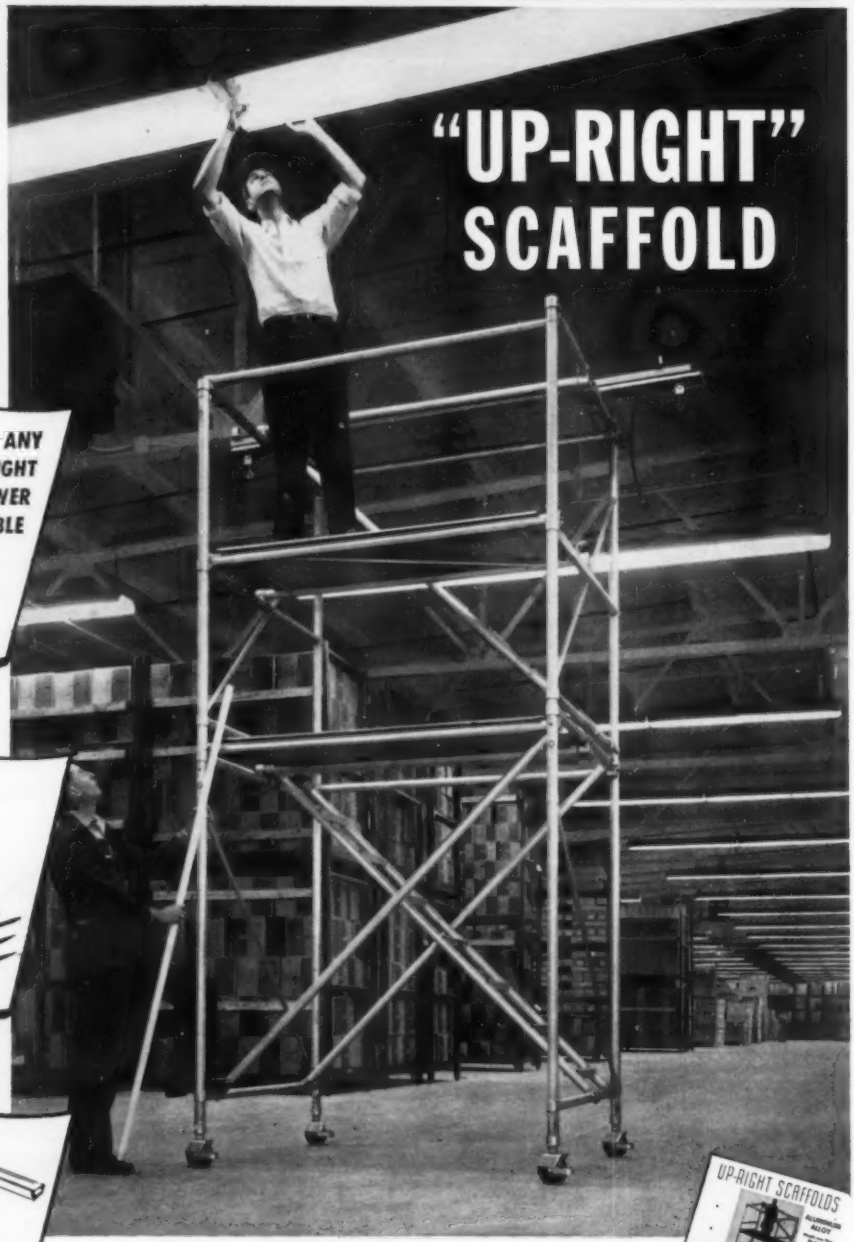
*A Division of Berger Machine Products, Inc.*



WALTER D. VANCE, JR., *Vice President* • *California Electric Co., reports:*

## *"We saved 14 days installing 527 fixtures by using 'UP-RIGHT' Scaffold-on-Wheels"*

Man-hour savings on this General Motors warehouse job amounted to over 40%. Up-Right Scaffold is so light it is easily assembled by one man. Individual 1 piece aluminum alloy sections are unfolded and set one on top of the other. They lock into place instantly.



*Write for descriptive circular* ➡

**"UP-RIGHT" SCAFFOLDS**

Dept. 159 • 1013 Pardee Street • Berkeley, California

Factories: Berkeley, Calif. and Teterboro, N. J. • Offices in all principal cities

*Wherever quiet is essential...*

THE NEW LEVITON

# QUIET SWITCH

For bedrooms, sickrooms, nurseries, libraries, hotels, hospitals and other places where "peace and quiet" are essential . . . the new Leviton QUIET SWITCH is just what is needed.

A lifetime switch that is tops for quality, reasonable in price and modern in quiet action. Everyone will be switching to the new Leviton Quiet Switch . . . cash in on the big demand for electrical wiring modernization.

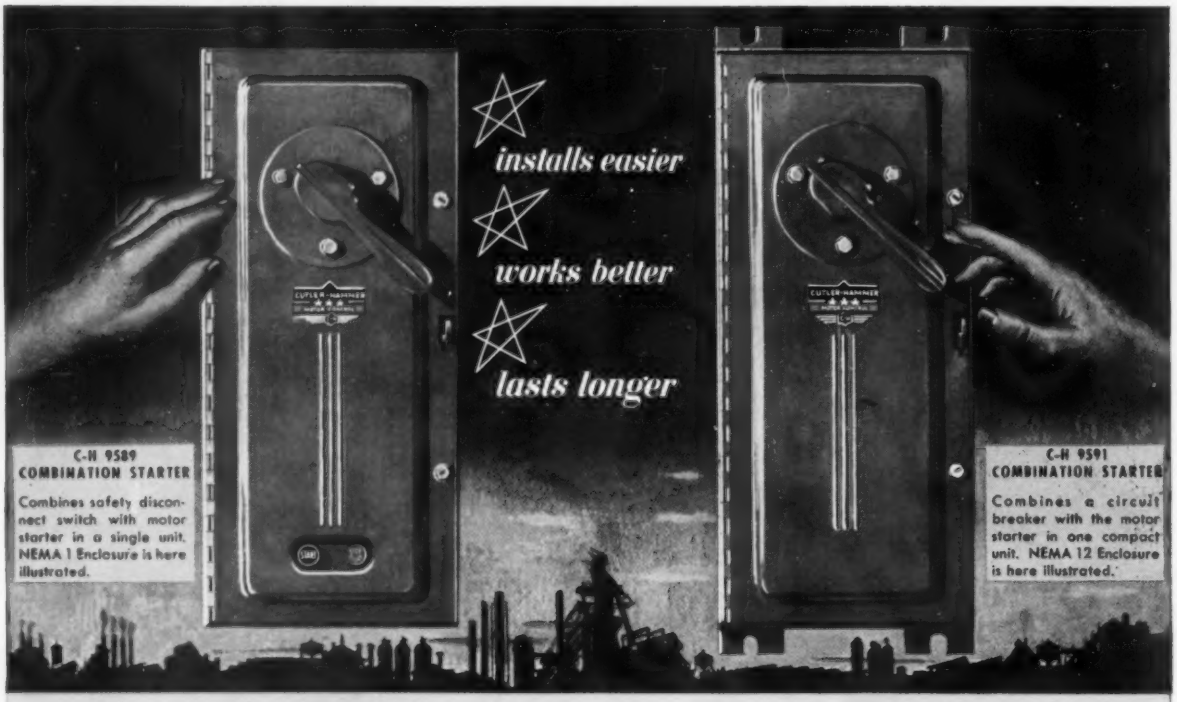
Available in single pole, double pole and 3-way . . . in either brown or ivory phenolic. Rating 15A 125-277V AC only. Meets UL and CSA specifications. Write for descriptive literature.

*Your best jobs are done with* ... **LEVITON**

LEVITON MANUFACTURING COMPANY – Brooklyn 22, N. Y.
Chicago, Los Angeles, Leviton (Canada) Limited, Montreal

For your wire needs, contact our subsidiary AMERICAN INSULATED WIRE CORPORATION

# New Combination Starters in the Spectacular Line of Cutler-Hammer ★★★ Motor Control

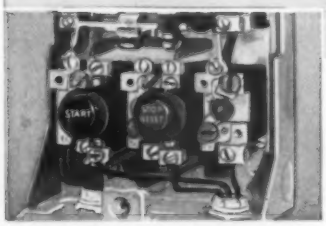

installs easier
works better
lasts longer
C-H 9589
COMBINATION STARTER
Combines safety disconnect switch with motor starter in a single unit. NEMA 1 Enclosure is here illustrated.
C-H 9591
COMBINATION STARTER
Combines a circuit breaker with the motor starter in one compact unit. NEMA 12 Enclosure is here illustrated.

Users have had many dramatic proofs of the advantages built into Cutler-Hammer ★ ★ ★ Motor Control. They *know* the three silver stars on the Cutler-Hammer nameplate identify control equipment that sets three entirely new standards of motor control performance and value. Star #1: Amazing savings in installation costs which often exceed the cost of the control. Star #2: Performance so uniform and dependable that *this* control often saves many times its cost by the production interruptions it avoids. Star #3: Life so greatly increased that this control *never* requires maintenance expense in 90% of its uses.

Now combination starters are available in this spectacular new line of Cutler-Hammer ★ ★ ★ Motor Control. Your nearby Cutler-Hammer Authorized Distributor has been stocked and is ready to serve you. Bulletin 9589 Starters incorporate a rugged disconnect switch of advanced design with or without fuses. Bulletin 9591 Starters are equipped with circuit breakers. Order *now* for prompt delivery.

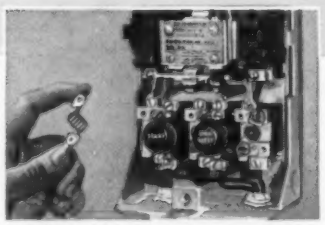
CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
★ ★ ★
MOTOR CONTROL
C-H



**Full Three-Phase Protection**

Only *three* overload relays can give complete three-phase protection to avoid motor burn-outs and their costly interruptions to production. And *only* Cutler-Hammer offers this complete three-phase protection in standard combination starters. You pay only for the third relay, nothing extra for special engineering or special enclosures.



**Adjustable Load Sensing Coils**

The accurate adjustment of overload protection permits motors to work harder without damage to motor windings. This is more important than ever with the newer type small frame motors. Adjustable load sensing coils in these new starters provide 3% loading accuracy instead of the 10% to 12% accuracy in competitive control.

**Superlife Vertical Contacts**

Experienced control users insist on dust-safe vertical contacts. And now the famous Cutler-Hammer vertical contacts have been doubly improved. First, their new lightweight design cuts bounce to reduce arcing. Second, any arcing that might occur is now pressure-quenched. Compare performance and see the difference.

# PARANITE-PARASYN®

**TYPE TW SMALL DIAMETER BUILDING WIRE FLAME AND MOISTURE RESISTANT....**

Paranite Parasyn is thermoplastic insulated and withstands exposure too severe for rubber insulated wires. UL approved for 60° C where exposed to oil and 80° C in air operating temperature. Small size lets you add additional circuits in existing conduits or raceways . . . or use smaller sizes of conduit and fittings. Available in eight permanent colors for easy circuit identification. Sizes 14 to 500MCM.

**PARANITE WIRE AND CABLE**
*DIVISION ESSEX WIRE CORPORATION*
**Fort Wayne 6, Indiana**
MANUFACTURING PLANTS: Birmingham, Ala.; Anaheim, Calif.; Jonesboro, Ind.; Marion, Ind.

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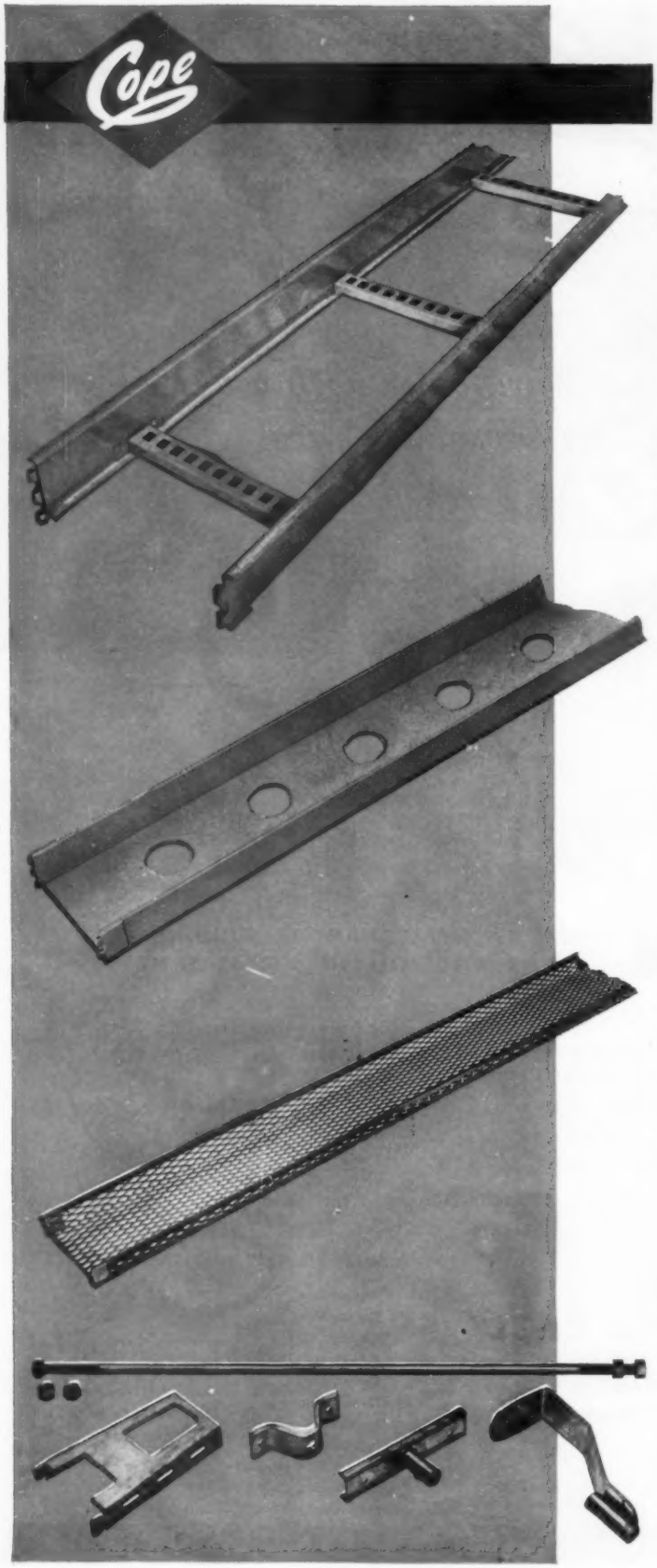
*San Diego, Calif.
*Saint Louis, Missouri
*San Francisco, Calif.
Seattle, Wash.
Springfield, Illinois




## CABLE LADDER

This new Cope product has been developed specifically for the support of interlock armor and other semi-rigid cables which require only intermittent support. Basically, the Cope Galvanized Steel Ladder consists of two main "Z" shaped stringers to which rungs are welded on 18" centers. The rungs are suitably slotted to permit cables to be quickly clamped to them with simple band type cable straps and pads. Cope Cable Ladder is supplied in widths of 6", 9", 12", 16", 18", 20" and 24" and in 12 foot lengths. Ladder sections have been designed to connect with Cable Trough of similar width. Horizontal and vertical fittings for all widths are standard items.

## CABLE CHANNEL

The Cope Cable channel has been designed to supplement ladder and trough by providing an economical means of supporting a limited number of armored or non-metallic jacketed cables — such as would occur in branch runs, etc.

Cope channel is available in 12 foot lengths in widths of 3" and 4". All sections except vertical risers are provided with ventilation and drainage holes. Horizontal and vertical fittings are also available.

## CABLE TROUGH

The popular expanded metal Cable Trough is ideal for supporting runs of non-metallic jacketed cables where continuous support is required. The trough is supplied in widths of 6", 9", 12", 18" and 24" and lengths of 8, 10 and 12 feet. Standard fittings for each width permit the trough to make changes in direction and elevation, join and cross, and, in short, conform to any plant layout.

## MOUNTING HANGERS

T. J. Cope, Inc. also supplies a complete line of quick connecting mounting brackets designed for maximum strength, durability, and versatility to support the Trough, Ladder and Channel. These supports can be hung from almost any structural member such as vertical or horizontal beams, cinderblock and cement walls and ceilings, and from existing conduit systems etc. All parts are hot dipped galvanized after fabrication.

## WITH THE EXCLUSIVE COPE PIN-TYPE COUPLER CUTS ASSEMBLY TIME 80%

T. J. Cope, for many years the leader in the design and manufacture of expanded metal Cable Trough systems, now offers to the electrical industry a *complete* standardized system of supports for *all types* of electrical cable.

This has been made possible by the addition of Cable Ladder and Cable Channel to the already popular line of Cope Cable Trough.

All units in the Cope system are equipped with the new pin-type couplers which permit sections to be joined together in a matter of seconds to form a strong mechanical joint without the use of nuts, bolts and washers.

Find out more about this complete supporting system. Write today for further information — ask for Bulletin 7M.

## and for the same reason: It's MOLD-CURED

All rubber floor coverings have to be vulcanized in a metal mold—mold-cured. It's the only way they can survive the punishment handed out by the hundreds of ton-miles of grueling wheel and foot traffic that is daily routine for most industrial installations. The toughness and resilience that only mold-curing can guarantee are the secret of rubber floors that wear on, not out.

Long-lived Hazacord cables have to be mold-cured, too; and they are. Bending, twisting, flexing, scraping, dependable portable cable service demands the toughness and durability that mold-cured Hazacord guarantees. Even, thorough vulcanization in a metal mold yields a compact cable assembly that is strong yet flexible, tough yet workable. And the Hazaprene ZBF sheath is permanently effective protection against flames, acids, alkalies, oils and moisture.

For any portable installation up to 15,000 volts, there is a mold-cured Hazacord construction that will save you money and trouble. Ask your jobber or your nearest Hazard representative or write for Bulletin H-451, Hazard Insulated Wire Works, Division of The Okonite Company, Passaic, N. J.

2145

**HAZACORD**

*Mold-Cured*

**portable cables**

PRODUCT OF OKONITE RESEARCH

## New RLM Specifications for:

1. ALL-WHITE PORCELAIN ENAMEL REFLECTORS (Inside and Outside)
2. INCREASED UPWARD LIGHT
3. MAXIMUM BRIGHTNESS
4. BETTER SHIELDING ANGLES
5. HIGHER REFLECTION FACTORS
6. HIGHER LIGHT OUTPUT
7. CAPTIVE LATCHING and HOLDING DEVICE
8. GROUNDED BALLAST MOUNTING
9. CHANNEL DESIGNED for SLIDING HANGERS
10. REVISED LAMP SPACING
11. IMPROVED LAMPHOLDERS
12. ENTIRE UNIT RUST-PROOFED

***NEW RLM SPECIFICATIONS BRING YOU BENEFITS LIKE THESE:***

- ✓ Greater Brightness Control
- ✓ More Seeing Comfort
- ✓ Less Lamp Glare
- ✓ More Light for the Money
- ✓ Greater Ease of Maintenance
- ✓ Greater Safety from Electrical Hazards
- ✓ Easier, Less Costly Installation
- ✓ Less "Trapped" Light
- ✓ Easier, Safer Lamp Removal and Replacement
- ✓ Longer Life

# Here's what these 12 ADVANCEMENTS in the NEW RLM SPECIFICATIONS mean to you in terms of BETTER INDUSTRIAL LIGHTING

The better lighting advantages listed above, highlight the many benefits that are yours as a result of the newly-established 1955 RLM Specifications for incandescent and fluorescent lighting units. With the ever-increasing importance of the right quality and quantity of light for greater efficiency in today's highly competitive industrial production, the selection of the proper lighting equipment becomes more important than ever. That is why these new 1955 RLM Specifications are more valuable than any set of industrial lighting specifications published during the RLM Standards 35-year history. That is the reason, too, why you benefit in more ways than ever before when you specify lighting units certified to carry the RLM Label. Today's RLM-labeled incandescent and fluorescent lighting equipment is made to the latest approved standards of illuminating engineering, to assure you of getting more light for your money now and for years to come. The newly-added specifications reflect American Industry's changing requirements for better light. That means not only higher footcandle levels, but also greater eye comfort . . . through greater brightness control. These, and many other advanced illuminating engineering principles are behind every RLM Label on every RLM-certified lighting unit. For a complete set of the new RLM Specifications, as well as other up-to-date lighting data, send for your free copy of the RLM Specifications Book.

Address your request to RLM Standards Institute, 819 West Madison Street, Suite 815, Chicago 6, Illinois

RLM STANDARDS INSTITUTE
INCORPORATED
The letters RLM stand for Reflector and Lighting Equipment Manufacturers

R1006

# When All things are

## ...the better lighting

All these things considered...

- 1. Specific Units for Every Need
- 2. Precision Construction
- 3. Low Installation Cost
- 4. Minimum Maintenance Cost
- 5. Lowest Over-All Cost

make BENJAMIN the choice for better lighting!

# considered

# choice is BENJAMIN!

. . . one of many Benjamin Leader Line units to be considered for School Lighting from classrooms to auditoriums.

. . . one of a complete line of Benjamin Leader Line units to be considered for Office Lighting from private offices to reception rooms.

. . . an example of the wide range of Benjamin Leader Line "area lighting" units to be considered for all types of stores, restaurants and other commercial locations.

*consider:*

## Specific units for every need!

. . . it's one of the five essential considerations for Better Lighting! It assures the buyer of getting exactly the right unit for the seeing task . . . maximum results from every lighting installation . . . at lowest possible operating and maintenance costs. Benjamin brings you the specific unit for every need without compromise! When you specify Benjamin or Benjamin Leader Line equipment, you never have to settle for a second choice. Here is a line that is *really complete* . . . as complete as over 50 years of specialization in the manufacture of quality lighting equipment can make it. Helpful folders on "Things to consider" for the lighting of schools, stores, offices and factories are yours for the asking. Write Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Illinois.

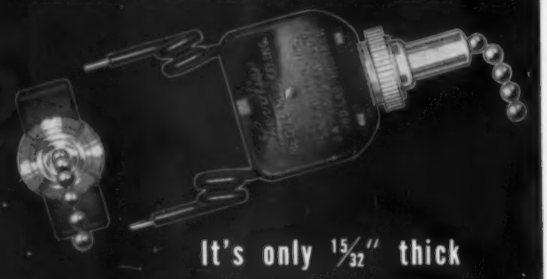
. . . just one of hundreds of Benjamin Industrial Units to be considered for Factory Lighting from assembly lines to foundries.

## BENJAMIN *Leader Line* LIGHTING EQUIPMENT

SOLD EXCLUSIVELY THROUGH ELECTRICAL DISTRIBUTORS

*Exclusive licensee of the Leader Line in Canada. Robertson Irwin Limited, Hamilton, Ontario*

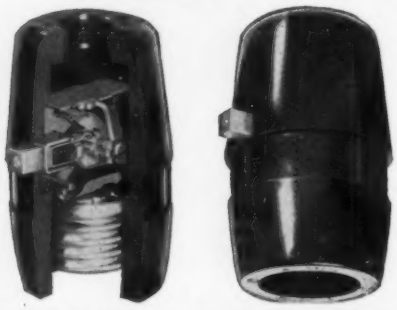
## Specify the *Levolier*® No. 71 WHERE SPACE IS LIMITED



### It's only 15/32" thick

Here's just the switch you need for your streamlined lighting canopies and fixtures, and FHP motor housings where switch space is limited. Only 15/32" thick, Levolier No. 71 fits in the smallest spaces. It carries Underwriters' "T" rating on the famous Levolier mechanism that assures dependable, trouble-free switch performance. Furnished with durable molded phenolic case, patented lever control, pull chain and 6" wire leads.

Model 4300-PB



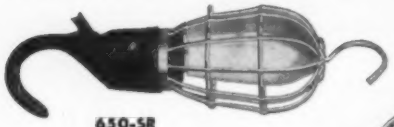
## RUGGED THROUGHOUT

### McGILL® industrial lampholders are built to outlast all others

From the mechanism through to the outer shell, McGill Lampholders are built heavier to last longer and cut replacement costs. They have a screw shell .006" heavier than standard, a proven-dependable Levolier switch mechanism, and an extra heavy, impact-resisting molded phenolic shell. Models are available with single and two-circuit mechanism, pull-chain, plain-lever and push-button control, with or without shade threads.

*only* McGILL *makes* *Levolier*® *Switches*

## HEAVY DUTY PORTABLE LIGHTING



650-SR

### Extra heavy cages with NO-ROL feature Molded Rubber Handles

McGill Rubber Handle Lamp Guards are heavy-duty, highly versatile and will last many times longer than ordinary portables in all industrial uses. The cage is built of extra-heavy steel wires, electrically spot welded and heavily zinc-plated. It has a bright chromate finish — open or closed end. Model 7100-SR fastens cage to handle with a clamping arrangement that makes lamp changing fast and easy without tools. Available with or without Levolier switch. Completely Underwriters' approved.

7100-SR

## *Levolier*® No. 21 offers LOW COST DEPENDABILITY

### in 3-amp switches

Especially durable — yet inexpensive, the Levolier No. 21 switch is the quality 3 Amp "T" 125 volt switch on the market today. It features pull-chain control and 6" wire leads permanently fastened to terminals by pressure connections. The molded phenolic case measures 1" x 1¼". Will accommodate mounting thickness up to 5/16". A desirable switch to put dependability into lower amperage current control.

50th McGILL Anniversary

YOU CAN DEPEND ON

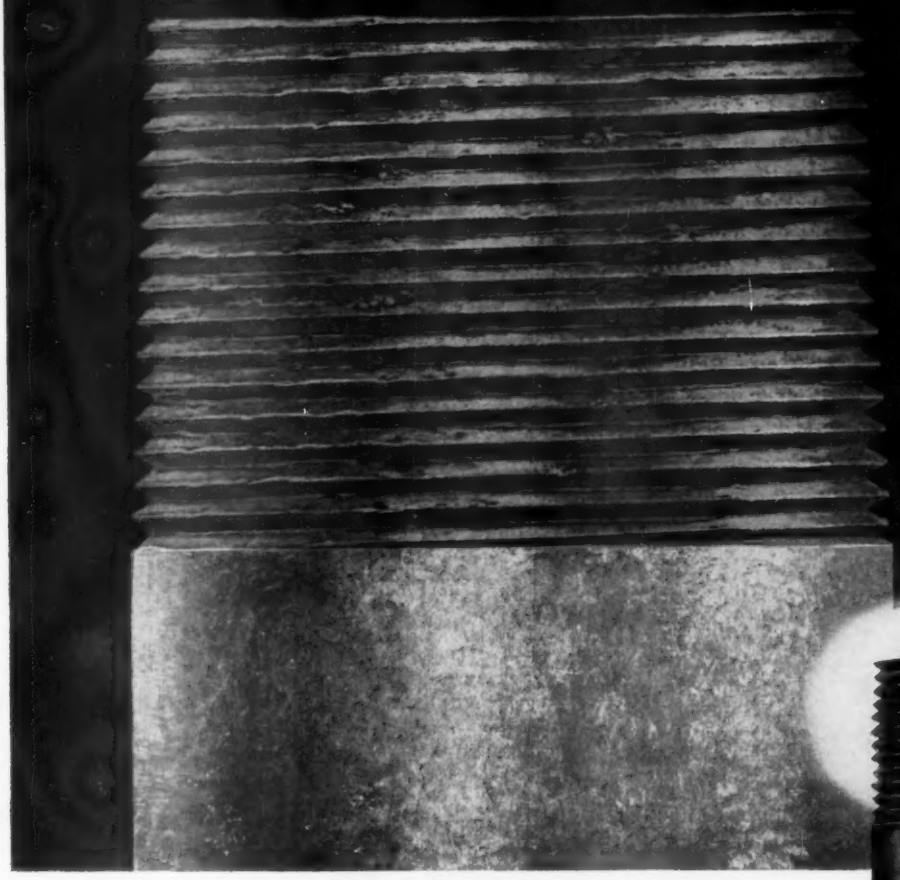
## McGILL QUALITY

**Available through leading Electrical Wholesalers**

For complete information on products of the McGill Electrical Division, write today for Catalog No. 49-A.

**McGILL MANUFACTURING COMPANY, INC.**
**450 N. Campbell St., Valparaiso, Indiana**

# why pay for rusty conduit threads?

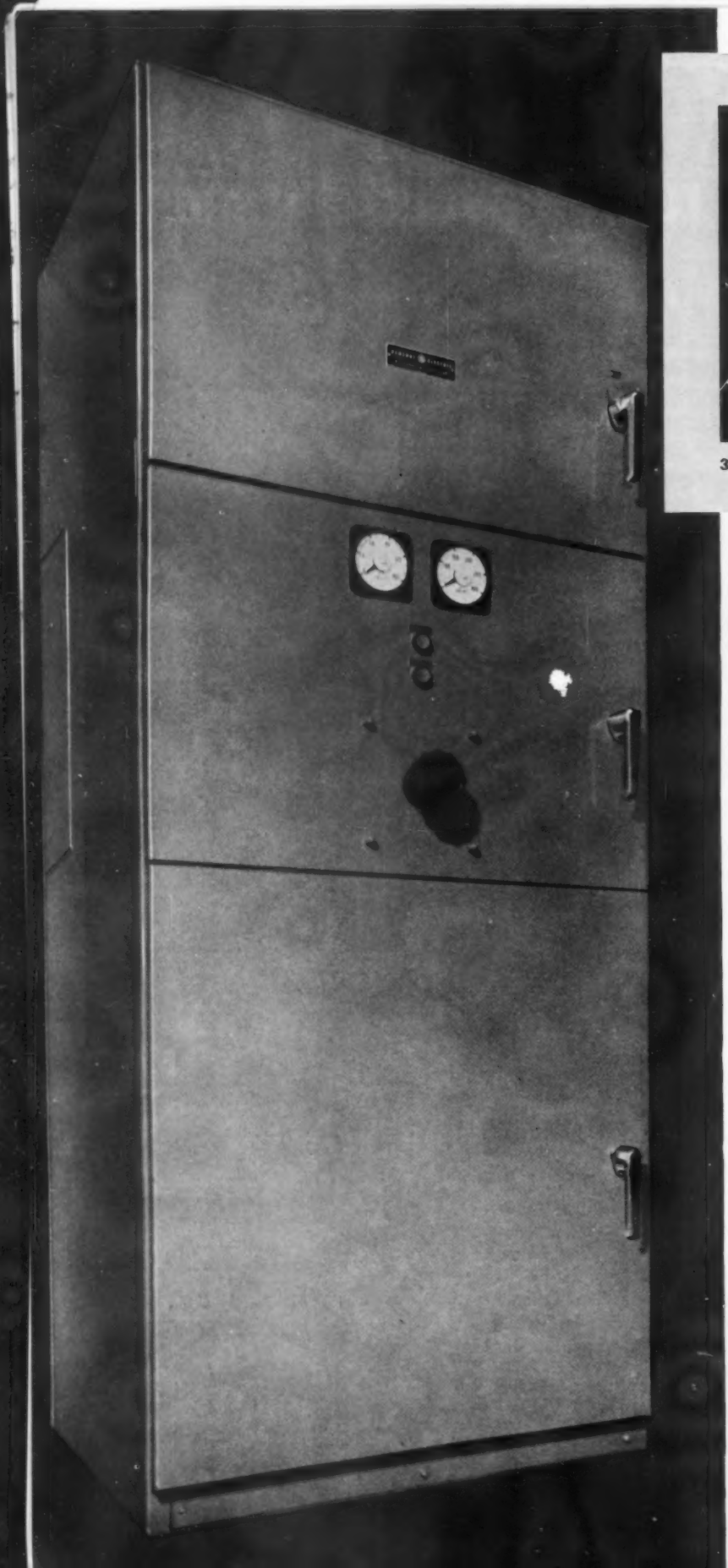


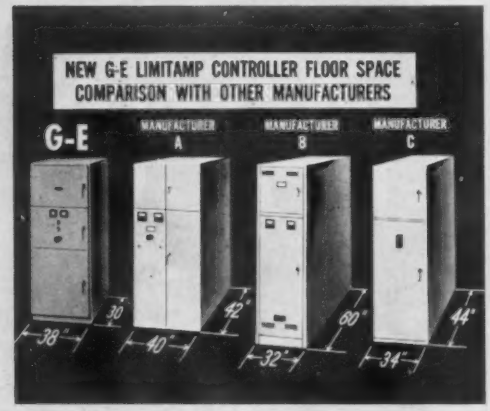
## BUY PITTSBURGH STANDARD—THE ONLY HOT-DIP CONDUIT WITH GALVANIZED THREADS

There's little point to paying for the "privilege" of chasing threads when you can get rust-free threads on hot-dip galvanized conduit from Pittsburgh Standard *at no extra cost*. Only because we have opened the world's most modern conduit mill at Morrisville, Pennsylvania can we give you this new "standard of the trade" in production quantities . . . and we are the only manufacturer who can. Call your nearest Pittsburgh Standard wholesaler today, or write us for his address . . . Pittsburgh Standard Conduit Co., 61 Bridge St., Pittsburgh 23, Pa.

PLANTS AT MORRISVILLE & ETNA, PA.

RIGID STEEL CONDUIT • ELECTRICAL METALLIC TUBING • ELBOWS • COUPLINGS • FITTINGS






**356 SQ. IN. LESS area than next smallest starter.**

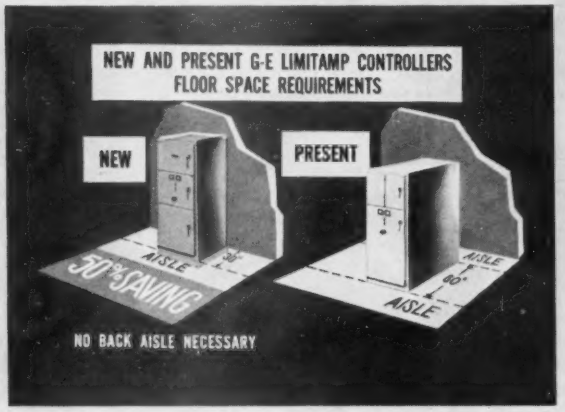
General Electric Announces . . .

# NEW Limitamp*

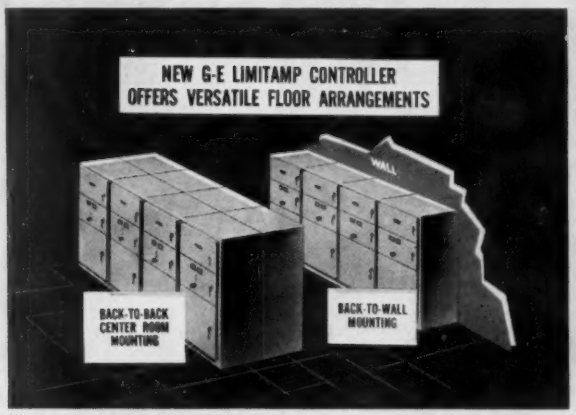
- **Gang-operated disconnect switch on all units**
- **Entirely front connected**
- **30-inch depth**
- **Low-voltage panel hinged to swing out of enclosure**
- **Contactor rolls in or out of cabinet**

## NEW DESIGN

**INSTALLATION IS SIMPLIFIED.** A man can easily enter enclosure to make connections.




OVER 50% SPACE SAVINGS by elimination of back-aisle.




VERSATILE INSTALLATION—units all front connected.

# Control saves over 50% floor space

**ENTIRELY FRONT CONNECTED,** only 30 inches deep, General Electric's all-new Limitamp control offers versatility of installation. New 30-inch depth allows unit to be transported through normal size doorways, and 90-inch height includes bus compartment. Back-to-back, back-to-wall, or mounting as free standing enclosure is now possible.

**IDEAL FOR HIGH-VOLTAGE MOTORS,** rated 2300-4800 volts and up to 3000 h-p, the new Limitamp control may be applied to squirrel-cage, synchronous, wound-rotor, and multi-speed motors on power systems requiring high interrupting capacity for maximum short-circuit protection.

**NEW CONCEPTS IN SAFETY** are built into new Limitamp control. Gang-operated disconnect switch, steel barriers between all compartments, enclosed bus compartment and co-ordination of starter assure you of safer high-voltage motor control.

**G.E. LIMITAMP STARTERS** are co-ordinated to provide maximum protection for equipment and personnel. Co-ordinated circuit components guard against needless fuse blowing, give running overload protection and provide maximum safe-guard against short-circuit damage for starter and equipment.

**FOR COMPLETE APPLICATION ENGINEERING** service contact your nearest G-E Apparatus Sales office. Write for Bulletin GEA-6331, Section 781-12, General Electric Co., Schenectady 5, New York.

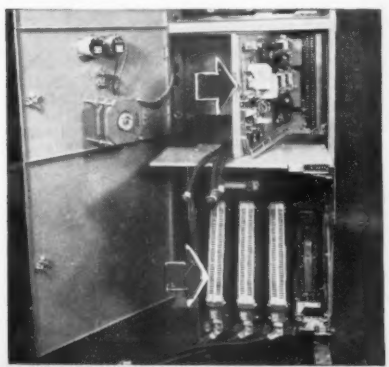
**Trade-mark of General Electric Company*

*Progress Is Our Most Important Product*

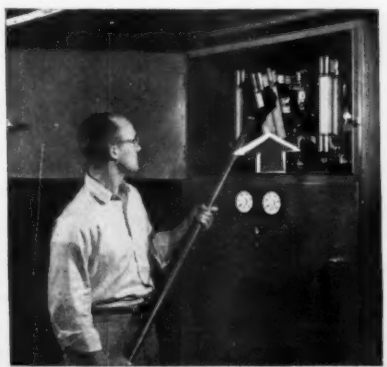
GENERAL ELECTRIC

## SIMPLIFIES INSTALLATION AND MAINTENANCE

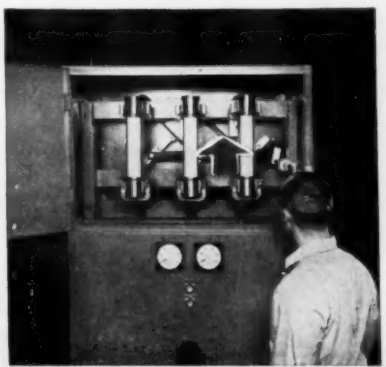
**MAINTENANCE IS EASY.** Low-voltage panel swings out, contactor rolls out.



**TYPE EJ-2 CURRENT-LIMITING** fuses are safely, quickly replaced within seconds.

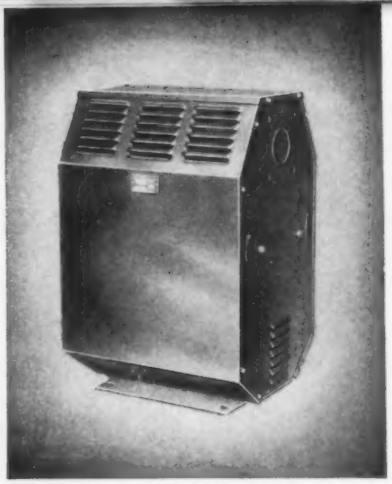


**SAFE VISUAL CHECK** of disconnect switch with fuse compartment door open.



## DRY-TYPE TRANSFORMERS

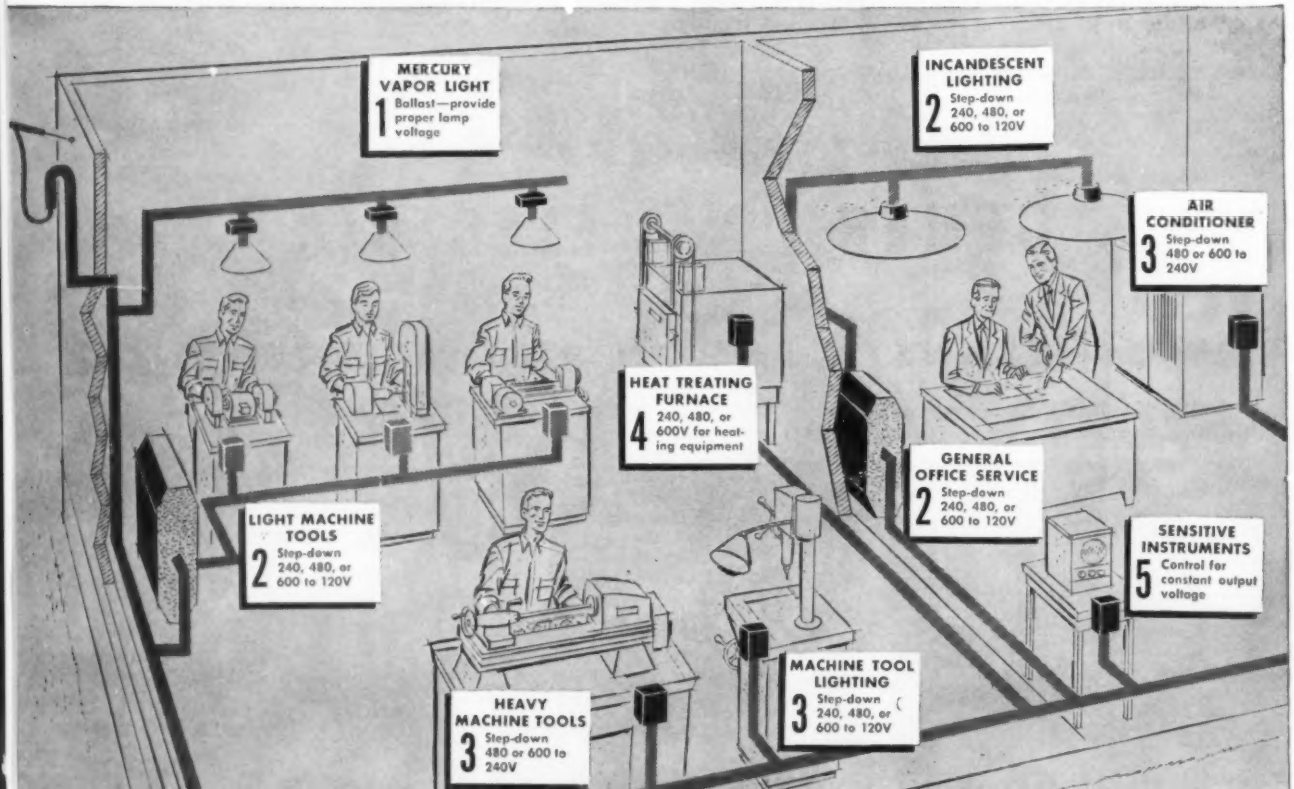
**1** **MERCURY LAMP** transformers can be specified for pendant or wall mounting. Roomy junction box behind nameplate makes wiring easy; six-inch leads speed installation.



**2** **TYPE D** transformers, for indoor service only, are ideal for general-purpose light and small power service. Available in ratings 25 kva and above.

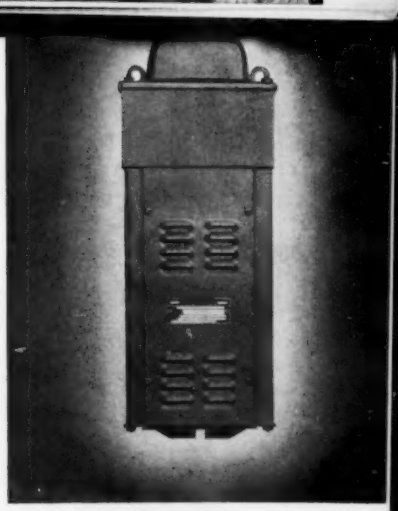
# Here's how five standard General assure you the proper operating

**THESE APPLICATIONS of General Electric dry-type transformers are typical of small plant and office installations served at 240, 480, or 600 volts and not requiring load centers. The numbers on the dry-type transformers in this illustration refer to equipment described above.**


MERCURY VAPOR LIGHT
1 Ballast—provide proper lamp voltage
INCANDESCENT LIGHTING
2 Step-down 240, 480, or 600 to 120V
AIR CONDITIONER
3 Step-down 480 or 600 to 240V
HEAT TREATING FURNACE
4 240, 480, or 600V for heating equipment
GENERAL OFFICE SERVICE
2 Step-down 240, 480, or 600 to 120V
LIGHT MACHINE TOOLS
2 Step-down 240, 480, or 600 to 120V
SENSITIVE INSTRUMENTS
5 Control for constant output voltage
MACHINE TOOL LIGHTING
3 Step-down 240, 480, or 600 to 120V
HEAVY MACHINE TOOLS
3 Step-down 480 or 600 to 240V

**3** **TYPE M** transformers for indoor or outdoor operation are also ideally suited for general-purpose light and power service. Available in all ratings through 15 kva.

**4** **SATURABLE REACTORS** provide a very efficient method of controlling voltages to heating equipment and other variable load devices. Available in ratings 3–300 kva.



**5** **VOLTAGE STABILIZERS** provide a dependable source of constant output voltage. Available in ratings 0.15 to 5 kva.

# Electric dry-type transformers can voltage you want, where you want it

## Dry-types in stock now will meet 90% of your requirements for precise voltage at the right place

G-E dry-type transformers, voltage stabilizers and saturable reactors, can be installed quickly . . . *at the load.* Standard models, ready for delivery, will meet most requirements. And you'll like the attractive price of G-E units!

The illustration at left demonstrates a few applications of G-E dry-types that are common in building modernization, expansion, and new construction where service is at 240, 480, or 600 volts.

Most electrical equipment for industrial or commercial use is not built to operate at distribution voltages. With dependable G-E dry-type transformers, you can obtain peak utilization of this equipment. G-E dry-types conserve power and copper feeders, and give accurate control because they can be installed at the load.

Standard units will fill your needs in most cases. In those instances where you need a special unit, we can modify a standard transformer, or build a custom-designed unit for you.

When you need assistance in voltage transformation or control, call your nearest G-E Distributor or Apparatus Sales Office. Or if you want prices and specifications on the standard units described above, complete the coupon and we'll promptly send the information. General Electric Company, Schenectady 5, New York.

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

MAKE GENERAL ELECTRIC YOUR SOURCE OF SUPPLY FOR ALL DRY-TYPE TRANSFORMERS

**General Electric Company**
**Section C410-8**
**Schenectady 5, New York**

**Please send me the following bulletins:**

- ☐ **LS-103 Mercury Lamp transformers**
- ☐ **GED-2024 M&D transformers**
- ☐ **GEC-976** } **Lighting transformers**
- ☐ **GEC-1208** }
- ☐ **GEC-1207 Distribution transformers**
- ☐ **GEC-1296 Saturable reactors**
- ☐ **GEA-5754 Voltage stabilizers**

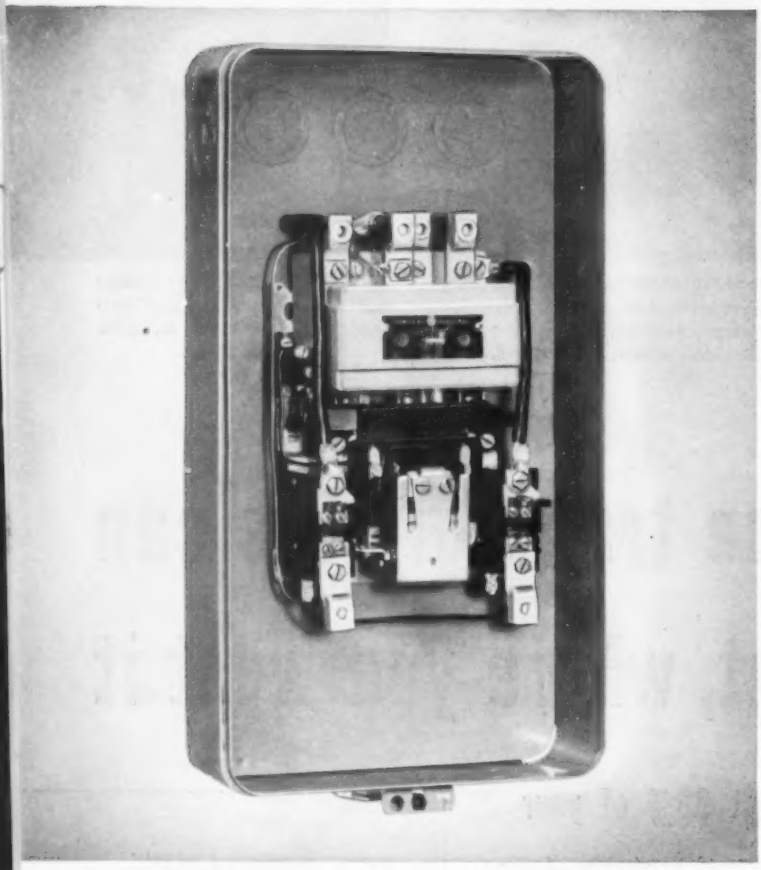
**Name**.....

**Company**.....

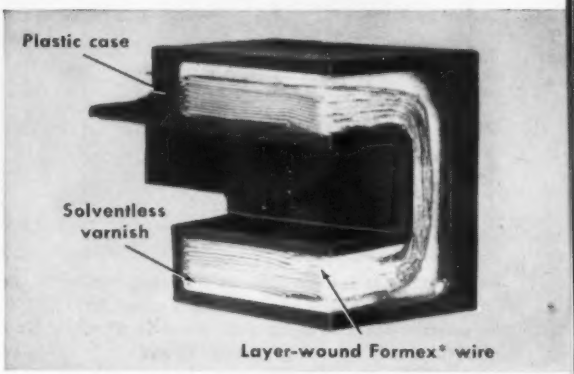
**Address**.....

**City**.....**State**.....

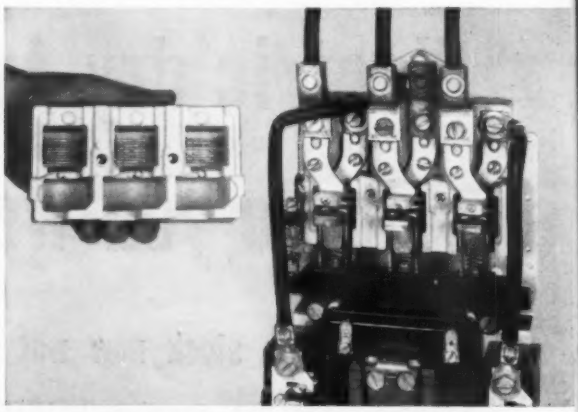
# NEW G-E SIZE 4 STARTER



**NEW SIZE 4 STARTER** is designed for full-voltage starting of squirrel-cage motors. Bi-metallic overload relays may be easily changed from manual to automatic reset without removing from case.

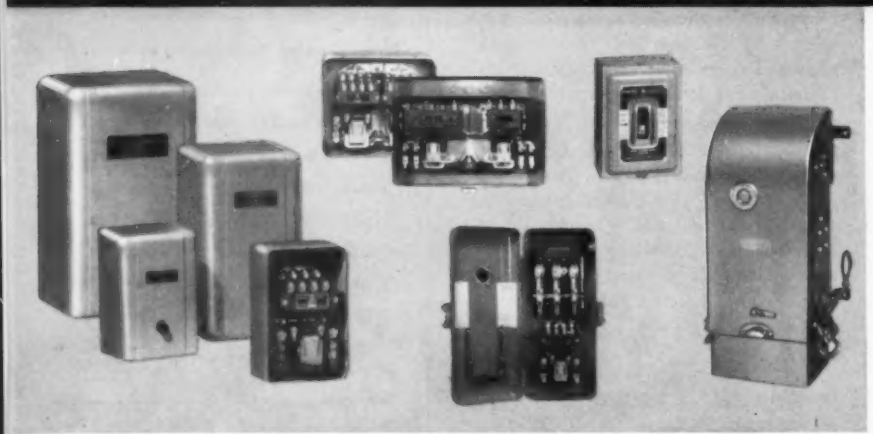



**STRONGBOX MAGNET COIL** is enclosed in a tough molded plastic case. Coil has firmly anchored terminals and is protected against dirt, oil and moisture.

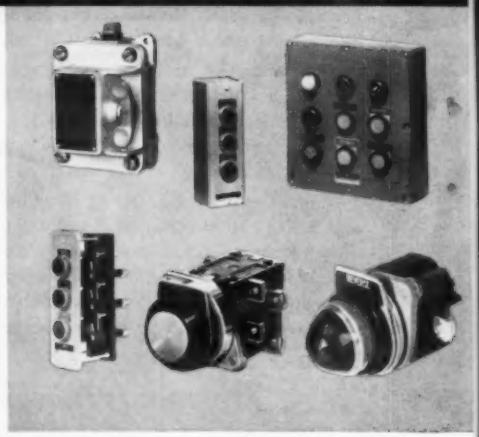


**SPECIAL ALLOY CONTACTS** give long weld-free life. Arcs are quickly extinguished by new blow-out design of contacts and cooling action of grids.

## CHOOSE FROM THE COMPLETE LINE

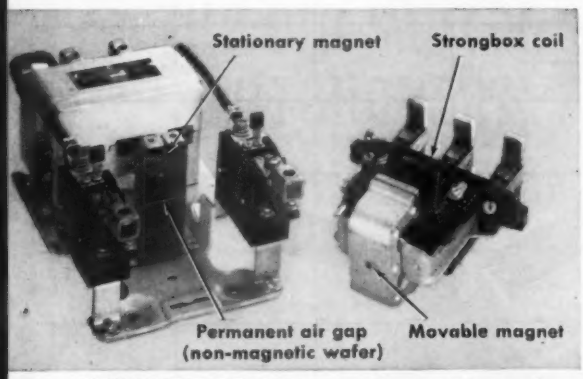


**THOUSANDS OF STARTERS** are available. They include: combination, reversing, multispeed, and manual and magnetic starters for full- or reduced-voltage starting. Starters are available in all popular NEMA and special enclosures.

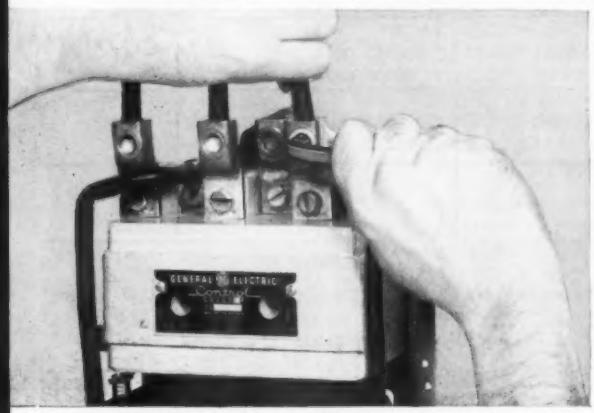


**PUSH BUTTONS** are furnished for standard, heavy-duty, or oiltight applications. Stations come in all NEMA enclosures.

# FOR 25- TO 100-HP MOTORS




**PERMANENT AIR GAP,** away from striking surfaces, can't wear down and cause starter to "stick-in." Magnet design prevents contact chatter.



**FRONT WIRED AND MOUNTED,** new starter has solderless, pressure-type terminals for wires from AWG No. 6 to 250,000 c.m. 3-point front mounting is easy.

## New magnetic starter for squirrel-cage motors

General Electric now adds a new, compact, NEMA Size 4 starter to its complete line of magnetic starters. The new starter offers many customer-proved features of size 0 to 3 G-E magnetic starters, such as the strongbox coil and the permanent air gap.

**INSTALLED FROM THE FRONT,** the new starter has 3-point mounting, and is completely accessible from the front when mounted. Right up in front are the solderless, pressure-type terminals for easy wiring. Also, 3 electrical interlocks, in any combination, can be installed from the front without removing the arc chute or movable-contact assembly. A vertical or horizontal mechanical interlock is also available for reversing and multispeed controllers.

**MAINTENANCE IS EASY,** and a screwdriver is the only tool required. Contacts are readily changed, and both coil and contacts are removable from the front without disturbing power wiring.

**FOR MORE INFORMATION,** contact your nearest G-E Apparatus Sales Office or Distributor, or mail in the coupon below. Ask for Bulletin GEA-6322.

**Reg. Trade-mark General Electric Co.*

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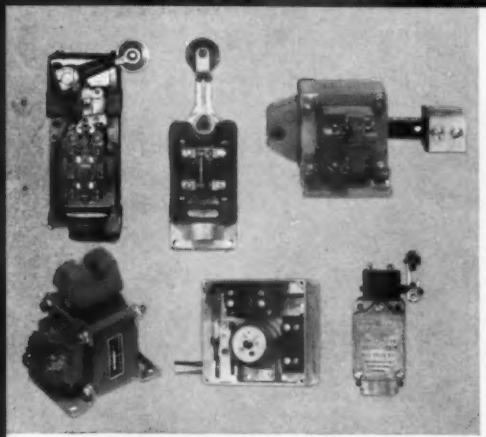
**GENERAL ELECTRIC**

## OF G-E CONTROL DEVICES



**LIMIT SWITCHES AND SOLENOIDS** include lever and cam type limit switches, and the new strongbox solenoid.

**G.E.'s LINE OF SWITCHES** include pressure, vacuum, float, plugging and anti-plugging, pilot and reversing switches.

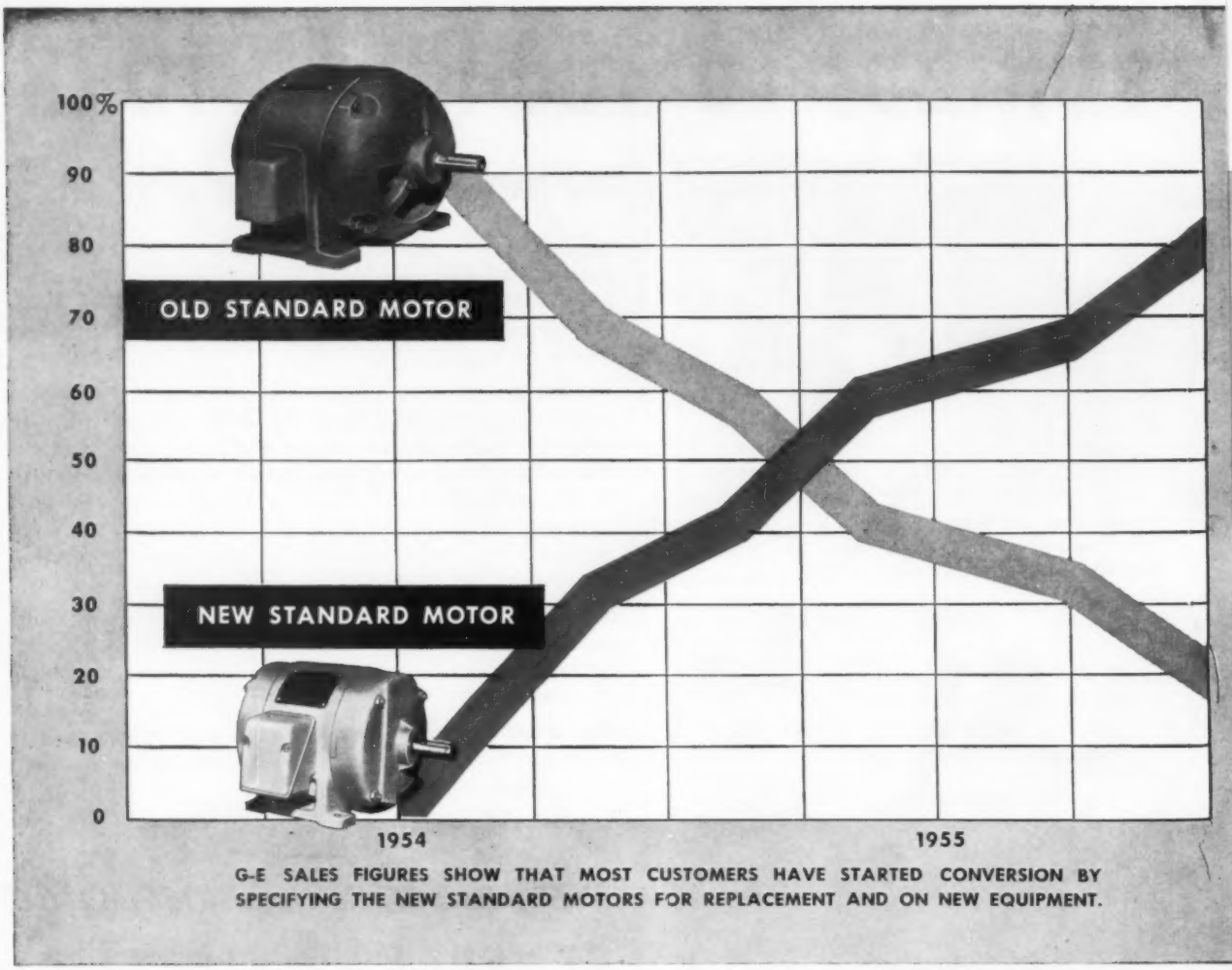
**FREE NEW CATALOG of G-E General Purpose Controls.**

Advertising and Sales Promotion Sect. E734-2
General Purpose Control Department
General Electric Company
Bloomington, Illinois

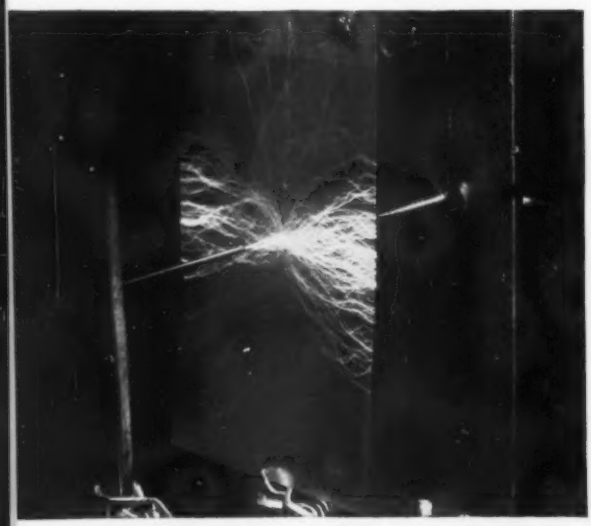
Please send a free copy of:

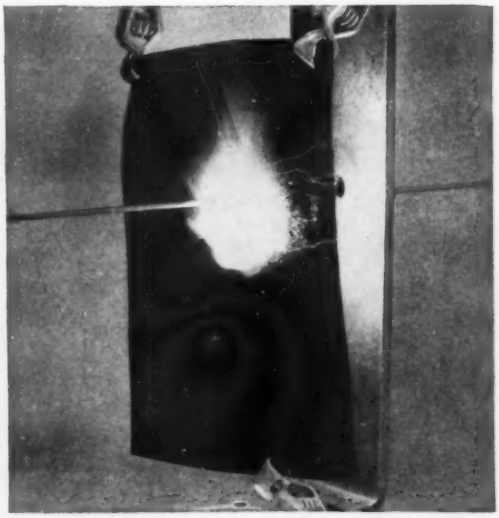
- ☐ GEC-1260A New Control Catalog
- ☐ GEA-6322 New Size 4 Starter
- ☐ For reference ☐ For immediate project

Name.....
Title.....
Company.....
Address.....
City.....State.....




G-E SALES FIGURES SHOW THAT MOST CUSTOMERS HAVE STARTED CONVERSION BY SPECIFYING THE NEW STANDARD MOTORS FOR REPLACEMENT AND ON NEW EQUIPMENT.





**NEW "MIRACLE" INSULATION,** polyester film, is shown at left withstanding a tremendous high voltage blast. The insulation used in most ordinary motors (right) burned out at about one-third that amount of voltage. Tests like this one show why the new G-E Tri-Clad '55' lasts longer than ordinary motors.

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

**50% MORE POWER** for their new centerless grinder was realized by the Van Norman Co., Springfield, Mass., when they switched to G.E.'s new motor. The new 7½-hp motor fitted in the space formerly occupied by a 5-hp motor.

# ARE YOU TAKING ADVANTAGE OF THE BIG 'MOTOR SWITCHOVER?'

Brand-new standards for 1 to 30-hp motors, proposed by motor manufacturers (NEMA) in 1953, have already been accepted by more than 75% of American industry.

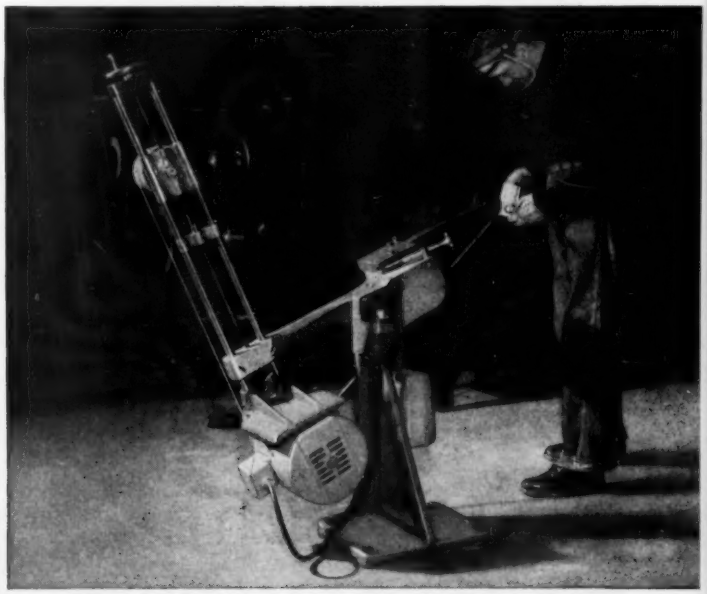
The major factor behind this rapid switchover is that motor buyers are now taking advantage of the longer life, lower maintenance, and better performance afforded by the new motors. Machine performance can be improved with the new G-E Tri-Clad* '55' motor, because of its higher full-load operating speeds.

**Users are also getting longer life** out of the new G-E motors, because of the new insulation which is 8 times stronger than ordinary motor insulation. Maintenance has been greatly reduced through the use of a new synthesized grease with 4 times greater lasting power, and permanumbered leads which can be identified even when taped or clipped.

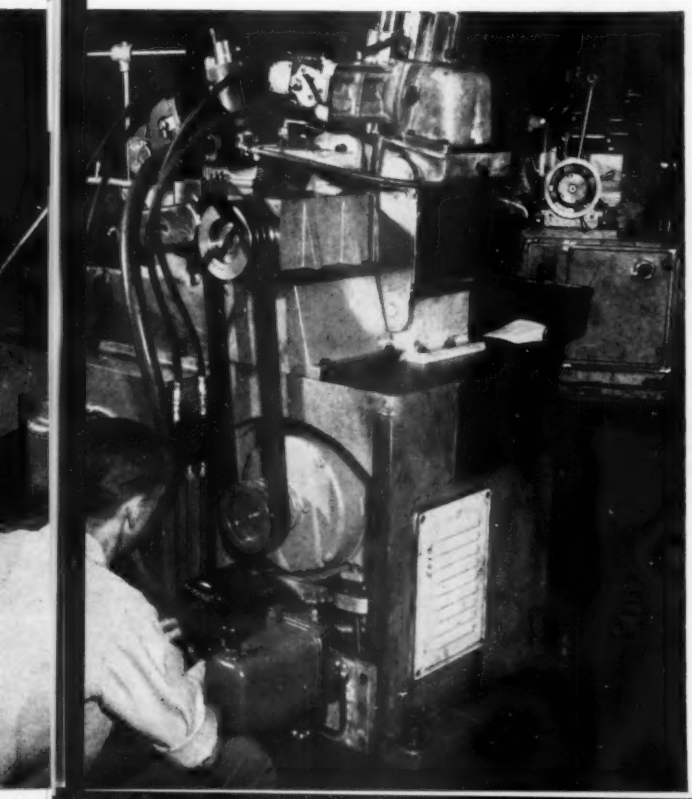
Are you investing in motor progress or motor obsolescence? You can take advantage of all these latest improvements if you specify G.E.'s new Tri-Clad '55' motor. Contact your G-E Apparatus Sales Office or authorized G-E motor supplier today. *General Electric Co., Schenectady 5, New York.* 648-28

*Reg. trademark, General Electric Co.

**"BEST PERFORMING MOTOR** that G.E. ever built," says W. J. Conery, chief design engineer of F. E. Myers & Bro. Co., Ashland, Ohio, about the new G-E Tri-Clad '55' motor. Higher full-load speed, smaller size and weight, and modern appearance permitted Myers to reduce size and improve performance of their Centri-thrift (left) and Ejecto (right) pumps.



**"FAR EASIER TO OPERATE** because of the new motor frame sizes," reports Stephen Bader & Company, Valley Falls, N. Y., in behalf of their new "Space-Saver" polishing machine. The 22% weight reduction in the 2-hp G-E Tri-Clad '55' motor allowed the machine to be redesigned for easier "one-man" handling. Higher full-load speeds permitted improved performance.



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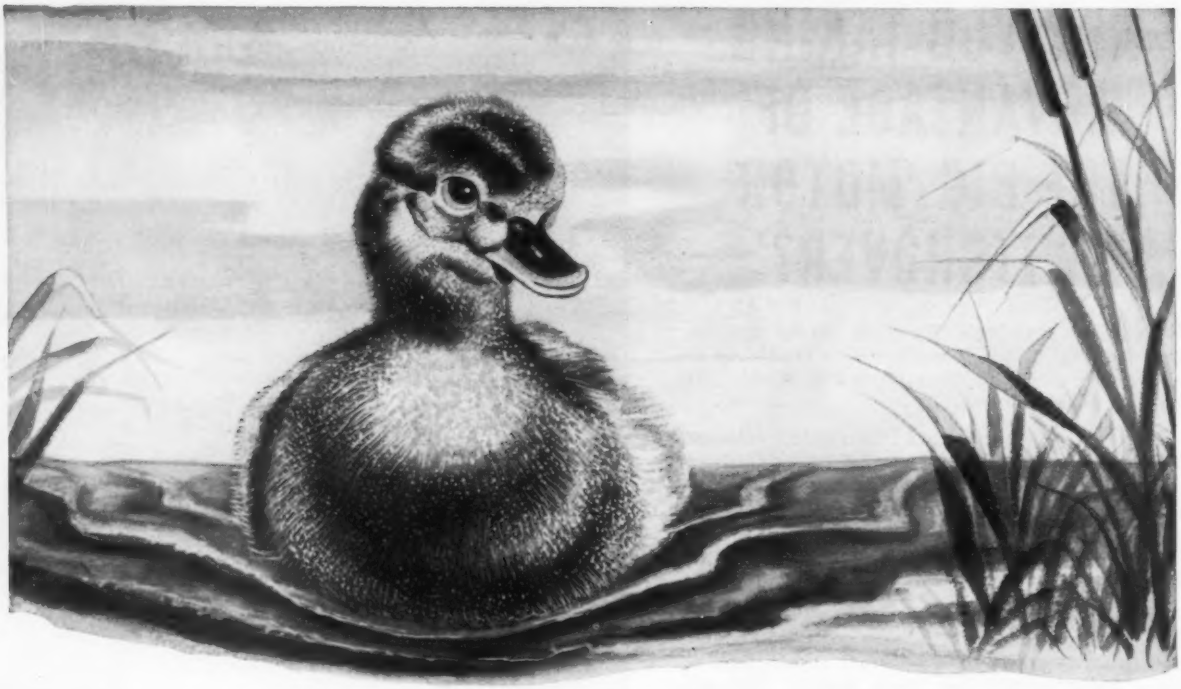

# SO SMO-O-O-OTH!

ORANGEBURG NOCRETE

ORANGEBURG STANDARD

Orangeburg Conduit provides the protection that means *longer life* for your *cables . . .* at *minimum cost.* Its *smooth bore* and *low coefficient of friction* are safeguards against abrasion when cables *go in* and *after they are in.*

Long-lasting *cable* protection is further assured by Orangeburg's tough, strong, resilient material, which resists acids, alkalies, salt, grease, oil . . . and by its impermeable wall and tight joints that keep out corrosive ground waters.

*Cost-Saving Advantages!* Orangeburg is quick, easy and economical to install because of its light weight, long lengths, readily-assembled joints, and the angle couplings, bends and other standard fittings furnished by Orangeburg. No wonder Orangeburg is a leader among Public Utilities, Municipalities, Industries and Electrical Contractors everywhere. Send to Dept. EC-75 for more facts.

**ORANGEBURG MANUFACTURING CO., INC.**

**Orangeburg, N. Y. — West Coast Plant, Newark, Calif.**

**ORANGEBURG® FIBRE CONDUIT**

**STANDARD** INSTALLED WITH CONCRETE

**NOCRETE** INSTALLED WITHOUT CONCRETE

Graybar ELECTRIC COMPANY

DISTRIBUTORS, ORANGEBURG FIBRE CONDUIT

BRANCHES AND STOCKS IN PRINCIPAL CITIES

GENERAL ELECTRIC SUPPLY COMPANY

A DIVISION OF GENERAL ELECTRIC DISTRIBUTING CORPORATION

FLORA BALLAST* SHOWS how easy it is to make across-the-counter in-warranty replacement of G-E ballasts at no cost to you, from your nearby G-E Ballast Service Center Distributor. They carry ample stocks of G-E ballasts from which you can select replacements for any make ballast.

*Flora* explains how . . .*

# More Than 800 G-E Ballast Service Centers Help You Save Lighting Dollars

When it is necessary to obtain an immediate ballast replacement you'll get prompt service at the G-E Ballast Service Center Distributor located nearest you. The complete stocks and convenient location help you save time and money. There are G-E Ballast Service Centers in every major city—more than 800 of them in the United States. Here you can make NO CHARGE in-warranty replacements of G-E ballasts . . . and replace *any make* ballast with a high quality G-E unit. And G.E. gives you top quality at low attractive prices too. Save time and money—solve your ballast replacement problems at your nearest G-E Ballast Service Center.

When you buy G-E ballasts you get other services too. G.E. maintains a network of national warehouses to speed volume orders. More than 150 trained sales engineers from G-E Apparatus Sales Offices are available to give you help in applying G-E ballasts and in servicing G-E ballast installations.

A G-E ballast tag or sticker on your fixture is proof that it is equipped with the best in ballast value. It's the easy way to be certain. For a complete presentation on G-E ballasts, contact the G-E Apparatus Sales Office nearest you or write Section 401-16, General Electric Company, Schenectady 5, New York.

*Miss Fluorescent Ballast, G.E.'s Ballast Mascot

*Copyright 1955, General Electric Company*

EXPERIENCED G-E BALLAST ENGINEERS are available to help you plan and service fluorescent lighting applications. For help, contact your nearest G-E Apparatus Sales Office.

*Five more reasons why*

GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- EXCLUSIVE SOUND RATING SYSTEM
- SUPERIOR QUALITY CONTROL
- LONGER BALLAST LIFE
- PRECISE LAMP-MATCHED DESIGN
- PROVED PRODUCT LEADERSHIP

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

# PIN POINTED FOR SERVICE

Youngstown has 28 district sales offices conveniently located throughout the nation to serve you quickly. They are staffed with men who know the steel business thoroughly and are qualified to help you with your steel requirements. You can get quick service whether you write, wire or phone your nearby Youngstown District Sales Office.

QUALITY YOUNGSTOWN SERVICE

## DISTRICT SALES OFFICES

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Phone Walnut 5920

Boston 16, Mass.
250 Stuart Street
Phone Liberty 2-5855

Buffalo 2, N. Y.
1508 Liberty Bank Bldg.
Phone Washington 6270

Chicago 2, Illinois
111 W. Washington Street
Phone Franklin 2-5470

Cincinnati 2, Ohio
1302 Carew Tower
Phone Main 1424

Cleveland 13, Ohio
2400 Terminal Tower Bldg.
Phone Main 1-2605

Columbus 15, Ohio
2850 LeVeque Lincoln Tower
Phone Capitol 4-7211

Dallas 2, Texas
1602 First Nat'l. Bank Bldg.
Phone Riverside 9538

Denver 2, Colorado
814 Continental Oil Bldg.
Phone Main 3-2283

Des Moines 9, Iowa
437 Insurance Exchange Bldg.
Phone 3-1265

Detroit 2, Michigan
926 Fisher Bldg.
Phone Trinity 5-5816

Grand Rapids 2, Michigan
604 Michigan Nat'l. Bank Bldg.
Phone 9-4291

Houston 2, Texas
1350 Esperson Bldg.
Phone Fairfax 1325

Indianapolis 4, Indiana
520 Circle Tower
Phone Melrose 2-3461

Kansas City 6, Mo.
1222 Commerce Bldg.
Phone Victor 5837

Los Angeles 15, Calif.
714 W. Olympic Blvd.
Phone Prospect 7581

Milwaukee 3, Wisc.
2110 Wisconsin Tower
Phone Broadway 1-5148

Minneapolis 2, Minn.
1050 Baker Bldg.
Phone ATlantic 2970

New Orleans 12, La.
520 Whitney Bldg.
Phone Raymond 0153

New York 36, New York
500 Fifth Avenue
Phone Lackawanna 4-4340

Philadelphia 2, Pa.
1502 Girard Trust Bldg.
Phone Rittenhouse 6-9830

Pittsburgh 22, Pa.
Two Gateway Center
Phone Atlantic 1-2350

St. Louis 3, Mo.
611 Shell Bldg.
Phone Geneva 6-1223

San Francisco 5, Calif.
55 New Montgomery Street
Phone Garfield 1-6544

Seattle 4, Washington
457 Central Bldg.
Phone Main 6420

Tulsa 3, Oklahoma
1305 Philtower Bldg.
Phone 54-4634

Washington 5, D.C.
327 Bowen Building
Phone Republic 7-2340

Youngstown 1, Ohio
505 Stambaugh Building
Phone Riverside 7-0771

## THE YOUNGSTOWN SHEET AND TUBE COMPANY

*Manufacturers of Carbon, Alloy and Yoloy Steel*

**General Offices: Stambaugh Building - - Youngstown 1, Ohio**
**Plants: Youngstown, Ohio; Struthers, Ohio; Indiana Harbor, Indiana**

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

**Du Pont changed some molecules...**

# to produce the higher heat resistance

## of ALATHON®

**polyethylene resin**

From the Du Pont laboratories comes "Alathon" polyethylene resin with increased heat resistance for insulation and jacketing. This extra measure of protection for copper and aluminum conductors is in addition to other important properties, such as weatherability.

Jacketing of "Alathon" has outstanding dielectric strength. This material is lightweight and pliable; users find it easy to handle. Jacketing of "Alathon" provides real economy because it lasts for years without festooning or splitting. Another advantage is its low rate of water absorption.

For more property and application data on the family of Du Pont "Alathon" polyethylene resins, clip and mail the coupon below.

**There is a difference in polyethylenes - specify ALATHON®**
**polyethylene resin**

DU PONT

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

E. I. du Pont de Nemours & Co. (Inc.)
Polychemicals Department
Room 447, Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited, P. O. Box 660, Montreal, Quebec.

Please send me complete information on Du Pont "Alathon" polyethylene resins. I am interested in evaluating these materials for.....

.....

*Name*_____ *Position*_____

*Firm Name*_____

*Street Address*_____

*City*_____ *State*_____

*Type of Business*_____

## You can SEE it's more pleasant to do business with this store ...Lighting by LITECONTROL

INSTALLATION: Strawbridge & Clothier Department Store, Jenkintown, Pennsylvania

ARCHITECT: Herbert Beidler, Chicago, Illinois

ELECTRICAL CONTRACTOR: Ross Electric Construction Company, Philadelphia, Pennsylvania

FIXTURE: No. 3334RS 3 lamp recessed Rapid Start troffers, with Albalite #66 glass, and special plaster frames
No. 3300-31 insert type incandescent lens boxes
No. 3300-41 insert type adjustable spotlites

INTENSITY: Average on counter tops, 40 footcandles in service

This department store installation at Jenkintown, Pa. is another example of how LITECONTROL *standard* fixtures can be successfully adapted to special conditions at appreciable savings.

In this somewhat unusual installation, we used a standard recessed fixture in combination with a special plaster frame with sloping sides as the fixture inset.

Flexibility is a keynote. A supplementary incandescent lens box or adjustable spotlite is lodged between the two fluorescent fixtures in the row. Lenses and spotlite assemblies are held in a hinged door, and may be interchanged as desired. If extra emphasis is desired on particular merchandise, a spotlite may be installed in place of a lens box. The hinged doors open by means of our Trigger catch — fingertip pressure opens them, an easy push closes them.

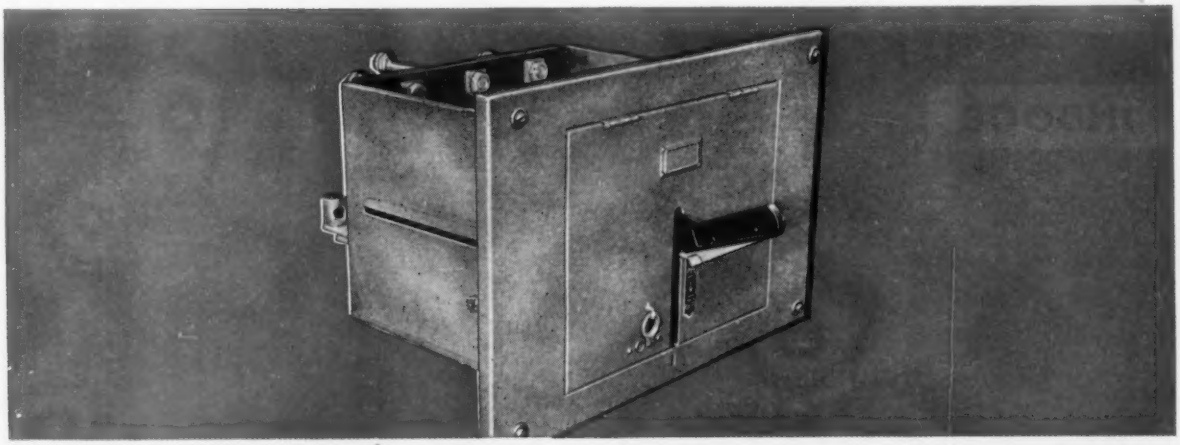
In stores and offices . . . wherever "things look better" LITECONTROL fixtures are providing "More Light and Looks for the Money." See your local LITECONTROL representative.

LITECONTROL *Fixtures*

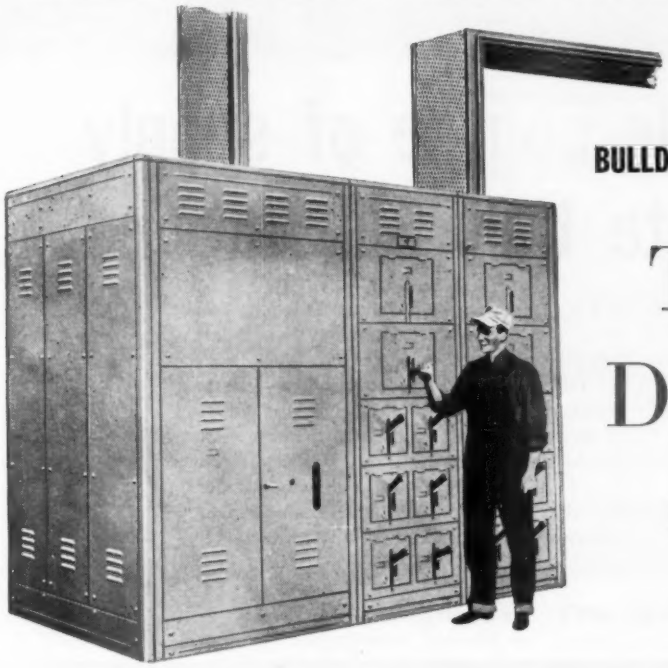
KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS



**BASIC BULLDOG SWITCH UNIT IS PROVED BY HUNDREDS OF INSTALLATIONS.** Switch and fuse units are available in capacities of 30 to 1200 amperes. I-T-E Circuit Breakers available in capacities up to 4000 amperes. All meters, instruments and current transformers are of finest quality. All equipment listed by UL.



## BULLDOG DF-50 SWITCHBOARDS GIVE YOU

# Time-tested Dependability

plus modern beauty!

## CUSTOM-TAILORED TO THE JOB AT A STANDARD PRICE!

How can you offer a custom-designed switchboard at a regular price? The answer is BullDog DF-50 Switchboards! Standard circuit breakers or fusible units in a standard enclosure with the most modern of finishes . . . individually tailored to fit the job's requirements.

BullDog field engineers will assist you as to the type, combination and arrangement of units needed for any specific application. Then you will receive a factory-built, custom-engineered switchboard that's designed for maximum protection and styled for the most modern factory or commercial building. Standardized, *performance-proved* components assure uniformly high quality and utmost dependability. Engineered to meet today's demands, BullDog DF-50 Switchboards are so advanced they will stay modern for years.

Consult your nearest qualified distributor or BullDog field engineer for assistance in selling and installing all your custom-engineered electrical distribution equipment. Or, write: BullDog Electric Products Company, Detroit 32, Mich.

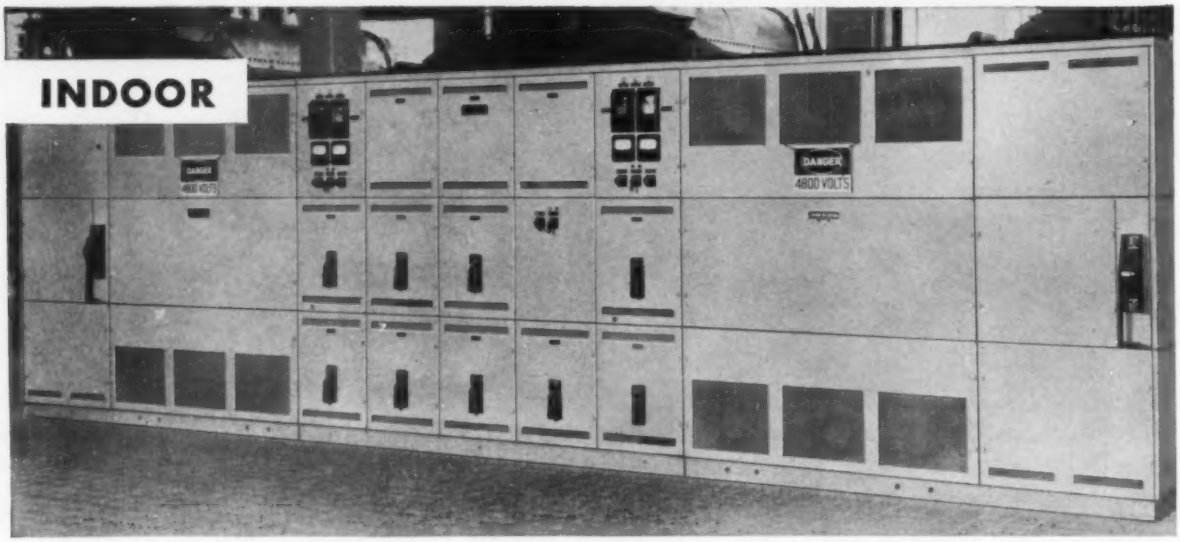
©BEPCO

*IF IT'S NEW*
*. . . IF IT'S DIFFERENT*
*. . . IF IT'S BETTER . . . IT'S*

**BULLDOG**

**ELECTRIC PRODUCTS COMPANY**
***A Division of I-T-E Circuit Breaker Company***

***Export Division:*** 13 East 40th Street, New York 16, New York. ***In Canada:*** BullDog Electric Products Company (Canada), Ltd., 80 Clayson Road, Toronto 15, Ontario.




# I-T-E, single source of supply for complete Unit Substations

You can buy a unit substation either of two ways: a piece at a time (the expensive way), or all at once (the economical way). I-T-E can sell you the individual elements, but recommends that substations be purchased complete, and from a single source of supply.

This way, you get more value from I-T-E's engineering assistance in over-all planning. The unit substation, including primary breakers or switches, liquid or dry type transformers, and secondary distribution switchgear with air circuit breakers, is assembled, tested and shipped as a unit ready for immediate installation. You have one dependable company that stands behind your complete installation.

I-T-E Primary and Secondary Unit Substations can be supplied for any application indoor or outdoor, and in any standard rating. For details, contact the I-T-E sales office nearest you. Look in your classified directory under "Electric Equipment." I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Philadelphia 30, Pa.

**I-T-E CIRCUIT BREAKER COMPANY, Switchgear Division**

# Check these features of SPANG® HD

## HEAVY-DUTY HOT-DIPPED } GALVANIZED CONDUIT

*...heavy-duty coating*

SPANG HD (Heavy-Duty, Hot-Dipped) Galvanized Conduit is coated with prime western zinc plus an "insurance coating" of clear lacquer to produce the best heavy-duty finish on galvanized rigid conduit you can buy!

*...high corrosion resistance*

SPANG HD zinc coating is well in excess of the standard thickness of zinc required by Underwriters' Laboratories, Inc., and American Standards Association. This protection makes SPANG HD highly resistant to corrosion and white rust.

*...uniform finish*

SPANG HD is air-wiped as it is removed from the galvanizing tank to produce a smooth outside finish. Superheated steam blown through the interior of the conduit assures a sleek, uniform interior finish for easy wire pulling.

*...strong bonding of finish*

After air treatment, SPANG HD Galvanized Conduit is immediately quenched to prevent grain growth of the zinc coating. This assures a strong bonded finish that won't crack or peel under severest bending strains.

## *All this...and Quality-control, too!*

Manufacturing factors such as controlled heat, controlled welding and controlled finishing produces in SPANG HD a strong conduit, easy to work with . . . makes it a top-quality conduit for top-quality installations. Try it on your next job!

Your local SPANG Distributor carries the complete SPANG line. Write to us for complete information and the name of your nearest SPANG Distributor.

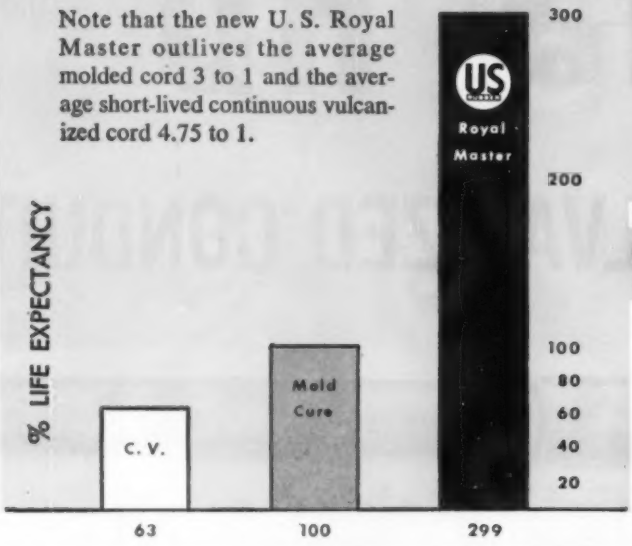
SPANG® CONDUIT

**SPANG-CHALFANT**
Division of The National Supply Company
GENERAL SALES OFFICE:
TWO GATEWAY CENTER, PITTSBURGH, PA.
District Offices and Sales Representatives in Principal Cities

# NEW!
## Amazing

**This chart summarizes individual service factors weighted by their contribution to overall service life.**

Note that the new U. S. Royal Master outlives the average molded cord 3 to 1 and the average short-lived continuous vulcanized cord 4.75 to 1.




## SUPERIOR!

**fibrous core protects against strain, withstands elongation.** Under impact, twisting and flexing the fibrous core (*inside* the annealed copper conductors) cushions and absorbs any strain, completely protects the conductors. This *unique* fibrous core also protects the conductors from any damaging *tensile* stress or strain.

## PATENT HAS BEEN APPLIED FOR!

Approved by Underwriters' Laboratories, Inc.

## SUPERIOR ON EVERY COUNT!

- 26% greater *oil* resistance
- 33% greater *heat* resistance
- 38% greater *tension* or breaking strength
- 50% greater resistance to *cutting*
- 58% greater *abrasion* resistance
- 118% greater resistance to *tearing*
- 197% greater *impact* strength
- 488% greater *flexibility*

TO THE AVERAGE OF MOLDED CORDS OF OTHER MAKES

US RUBBER

**UNITED STATES**

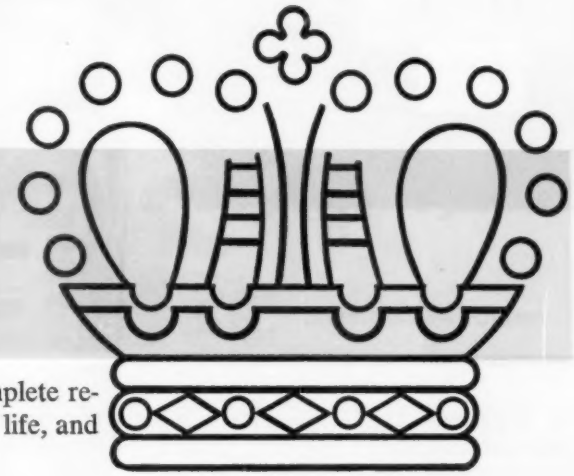
**ELECTRICAL WIRE & CABLE DEPARTMENT**

# U.S. ROYAL MASTER

## Portable Cords have 3 times longer cord life!

**SUPERIOR!** PATENTED LAYTEX® INSULATION GIVES ADVANTAGES UNMATCHED BY ANY OTHER CORD

- 90% unmilled grainless natural rubber with superior tensile strength and elongation
- Unmatched aging and moisture-resisting properties
- High dielectric strength
- High insulation resistance
- Unexcelled physical and electrical properties
- Free stripping characteristics
- Perfectly centered conductors



**LOOK FOR THE NAME — U.S. ROYAL MASTER**

Approved by Penna. Dept. of Mines and accepted for listing by the U. S. Bureau of Mines.

**THREE YEARS AGO,** "U. S." engineers began a complete re-examination of portable cord constructions, service life, and the causes of cord failure.

**OVER 12,000 TESTS** were made. More than a thousand cords of all leading makes, including our own famous U. S. Royal Cord, were analyzed, tested, and compared.

**EVERY LIFE FACTOR** was considered and carefully evaluated, alone and in its relation to overall cord performance and service life.

**BACKED BY 65 YEARS OF EXPERIENCE** in the manufacture of electrical wire and cable, U. S. Rubber engineers then translated their findings into an entirely new portable cord, designed to surpass any other previously made.

**U. S. RUBBER** is the only wire manufacturer to grow its own natural rubber, make its own synthetic rubber and its own plastics.

**EXTENSIVE TESTS, BOTH IN THE LABORATORY AND IN OUTSIDE PLANT INSTALLATIONS,** have proved this new portable cord startlingly superior in every respect!

**THE NEW U.S. ROYAL MASTER** is the crowning achievement in portable cords. No other cord approaches it in performance and economy.

The new line of U. S. Royal Master portable cords is obtainable from your "U. S." Distributor today.

**RUBBER COMPANY**

**ROCKEFELLER CENTER, NEW YORK 20, N. Y.**

# CUT "DOWN TIME"

# ECON®

dual-element cartridge fuses

Only Econ Fuses have the Econ-Alloy thermo element which has the property of changing from a solid to a liquid, without going through a plastic state. This makes possible Econ's faster and more accurate protection against harmless overloads and short circuits.

Available at leading electrical wholesalers in knife and ferrule types: 0 to 600 Amp., 250 to 600 V. Underwriters' Laboratories approved. Write us for new ECON Catalog S-60 or for Complete Line Fuse Folder.

**Your Electrical Wholesaler has ECON Dual-Element Cartridge Fuses in stock.**

**eliminate needless blows that "stall" production**

When production is held up, even for a short time, management and men both lose. Get dual protection against "down time" with Econ Dual-Element Cartridge Fuses on motors and branch circuits.

**1 ECONS give time-controlled protection against unnecessary blowouts from temporary and harmless overloads . . . a frequent cause of shut-downs.**

**2 ECONS give instantaneous protection against short circuits . . . operate at low temperature . . . prevent overheated circuits.**

ECONOMY fuses for every purpose

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago 14, Ill. 1044

*Underground incoming cables enter the unit on the right. The center unit serves air-conditioning equipment, and the left unit feeds the transformer seen alongside.*

MR. GLENN SHUTTS of White City Electric Co., Chicago, has recommended many installations of S&C Metalclad Switchgear, including the one at G. D. Searle & Co. He says, "S&C gear does the job at a considerable saving over other types. From a service angle it has been perfect . . . we have never had to go back . . . there has been no maintenance . . . no trouble whatsoever. All of our customers are absolutely satisfied. As a result S&C has received many repeat orders."

# You can cut the cost of your high voltage supply system

**Save up to 50% with S&C Metalclad Switchgear**

The installation pictured above—at G. D. Searle & Co., Skokie, Illinois—is another instance of S&C Metalclad Switchgear engineered to reduce the capital outlay for the construction of the electrical supply system.

At low cost—considerably lower than other types of switchgear—S&C equipment provides means for switching and protecting the high-voltage circuits. Its dependability is attested by the scores of successful installations now in service.

S&C field engineers will gladly work with you in reducing your high-voltage equipment costs . . . just pick up the telephone.

*Specialists in High-Voltage Switchgear for Electric Utilities since 1910*

## S&C ELECTRIC COMPANY

4433 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U.S.A.

IN CANADA:
S & C ELECTRIC CANADA, LTD.
8 VANSCO ROAD, TORONTO 14, ONTARIO

Consult your telephone directory. Sales offices located in Birmingham, Boston, Buffalo, Chicago, Clayton (St. Louis), Cleveland, Dallas, Dearborn (Detroit), Denver, Houston, Huntington, Indianapolis, Jersey City, Kansas City, Little Rock, Memphis, Minneapolis, New Orleans, Philadelphia, Pittsburgh, Portland (Ore.), St. Petersburg, Salt Lake City, San Francisco, San Gabriel (Los Angeles), Seattle, Syracuse, Washington, D. C.

# Testing Noise Levels

SORGEL transformers are known and chosen for their quiet operation, because their noise level is well below the established standards.

Because of their quiet operation, SORGEL transformers are particularly adaptable for indoor installations—in hospitals, schools, institutions, libraries, office buildings, stores, and other structures where low noise levels are an important factor.

Our new testing laboratory, with modern, complete testing equipment and facilities, enables us to know what the efficiency, noise level, temperature rise, and performance of SORGEL transformers are before the installation is made.

The liberal design of SORGEL transformers also results in high efficiency, long life, and a liberal overload capacity for emergencies.

SORGEL transformers are available in a large variety of sizes and types for every purpose. ¼ Kva to 2500 Kva single phase. 1 Kva to 3000 Kva 3-phase. All standard voltages, such as 120, 208, 240, 480, 600, 2400, 4160, 4800, 7200, 13,200, and up to 15,000 volts, and any intermediate or special lower voltages.

SORGEL dry-type or Askarel-cooled transformers are also incorporated in substations. Available with any type or make of switchgear, or from any substation manufacturer.

---

*Sales Engineers in Principal Cities*

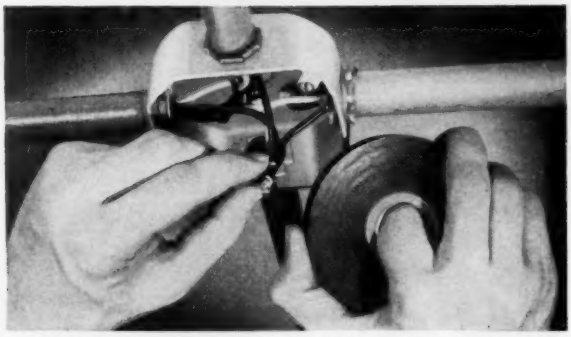
**SORGEL ELECTRIC CO., 836 West National Ave., Milwaukee 4, Wisconsin**

*40 years' experience in the development, manufacturing and application of transformers.*

# Whatever the job . . .

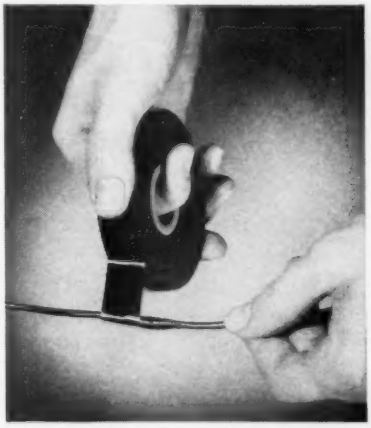
# PERMACEL TAPE

**PLASTIC CUTTER BAR** free with every 66′ roll of Permacel 29 Plastic Tape. It does away with scissors, knives and razor blades. A non-conductor. Durable and easy to use. It cuts waste, saves time.



**PERMACEL 29** will stretch to over twice its original length, permitting it to mold snugly to the work. The result is a tight, smooth wrap for splices in junction boxes and general wiring applications.

**ONE WRAP** does the job on television antennas. Permacel 29 resists weather . . . sticks tight. Requires less tape per job.



**NEAT, THIN SPLICES** with Permacel 29 Plastic Tape. Dielectric strength of 9,000 volts. Resists moisture, oil and abrasion.

**INSULATING TOOLS** is just one of a wide variety of general, electrical and automotive uses of Permacel 29 Plastic Tape.

SELF-STICKING

# PERMACEL® TAPES

*Many jobs can be done faster, better, easier with self-sticking tape . . . write Permacel Tape Corporation, New Brunswick, N. J.*

a Johnson & Johnson company

# *Constitution Hall, Washington, D. C.*

**(DAUGHTERS OF THE AMERICAN REVOLUTION)**

•

RELIGHTED BY RAMBUSCH UNDER THE SUPERVISION OF
BERNARD LYON FRISHMAN & ASSOCIATES, *Architects* • L. WARREN BOGAN & ASSOCIATES, *Consulting Engineers*

When it comes to lighting large and lofty interiors the Rambusch Downlite has no equal. It is efficient, safe, economical, simple to maintain, glare shielded and guaranteed to produce the promised results. • There are 100 Rambusch lighting representatives in the country—one of them is near you and anxious to serve you.

**RAMBUSCH** DESIGNERS • MANUFACTURERS
40 WEST 13th STREET, NEW YORK 11, N. Y.

# STRAPS...STRAPS...STRAPS...

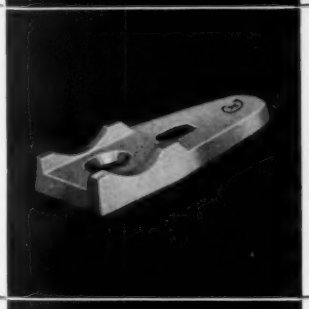
## and every one saves time every time

JUST LOOK at this Gedney line of straps! Every type you want... and every feature that speeds installation and pulls down installed costs. Malleable iron that stops breakage. Hot dip galvanizing that spells longest service life. Individual inspection that assures top quality. And all these straps are available in a full range of standard sizes... Order Gedney fittings from your wholesaler for today's best buy—and write us for your copy of the complete Gedney catalog.

**GEDNEY NAIL STRAPS** for rigid conduit, E.M.T., armored cable, S.E. cable, etc.

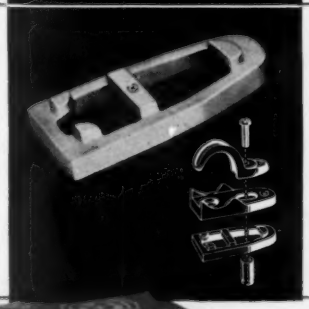
**GEDNEY ONE-HOLE STRAPS** for rigid conduit, S.E. cables, and E.M.T. Sizes ⅛" to 6". Hot dip galvanized.

**GEDNEY ONE-HOLE STRAPS** for oval cables. Hot dip galvanized.



**GEDNEY CONDUIT SPACERS OR CLAMP BACKS** for rigid or E.M.T. Hot dip galvanized.

**GEDNEY "UNIVERSAL" ONE-HOLE STRAPS** for S.E. cables. Hot dip galvanized.



**GEDNEY NEST BACKS** — a supplementary spacer for use with pipe straps and clamp backs. Hot dip galvanized.

**GEDNEY**
**ELECTRIC COMPANY**

GEDNEY

RKO BLDG. • RADIO CITY • NEW YORK 20
Foundry, Factory and Shipping Point: Terryville, Conn.

*Moisture and abrasion* won't hurt tough Neoprene sheathed Rome 50 Cords. And a Rome 50 Cord is flexible, easy to handle.

*It costs less* to specify flexible cords that can take hard day-to-day use. Rome 50 Flexible Cords are properly designed for long service life.

You can tell a good flexible cord *by the company it keeps.* Thousands of feet of Rome Flexible Cords are in use as original equipment on the fine hand and floor model vacuum cleaners made by The Singer Manufacturing Company.

## Measure the costs

Every time a flexible cord fails on the job, it costs you money—(1) money lost through job delay—down time—and (2) the expense of replacement.

If you use flexible cords frequently and use them hard, your best insurance against trouble is a durable Neoprene sheathed Rome 50 Cord. Correct design makes Rome 50 Cords flexible and easy to handle. And the inherent resistance to moisture, abrasion, oils, acids, flame and sunlight of the tough Neoprene sheath gives you the long cord life you need.

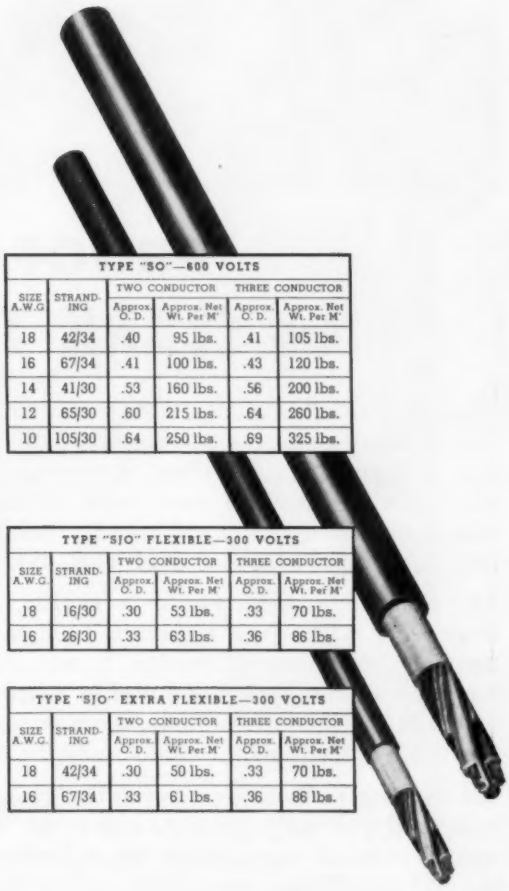
Rome 50 Flexible Cords are available in Types SO and SJO—economically priced.

Where service is unusually tough, it will pay you to check into the savings you can make with the extra heavy-duty cords and cables in the slightly higher priced Rome 60 line.

Contact your Rome distributor for service—Rome 50 for all around use—Rome 60 for extra heavy duty.

# of cord failure

*The inherent toughness* of a properly made flexible cord is your best assurance of long life. The all-resistant Neoprene sheath protects Rome 50 Cords against operating hazards.



| TYPE "SO"—600 VOLTS | | | | | |
|---|---|---|---|---|---|
| SIZE A.W.G. | STRANDING | TWO CONDUCTOR | | THREE CONDUCTOR | |
| | | Approx. O. D. | Approx. Net Wt. Per M' | Approx. O. D. | Approx. Net Wt. Per M' |
| 18 | 42/34 | .40 | 95 lbs. | .41 | 105 lbs. |
| 16 | 67/34 | .41 | 100 lbs. | .43 | 120 lbs. |
| 14 | 41/30 | .53 | 160 lbs. | .56 | 200 lbs. |
| 12 | 65/30 | .60 | 215 lbs. | .64 | 260 lbs. |
| 10 | 105/30 | .64 | 250 lbs. | .69 | 325 lbs. |

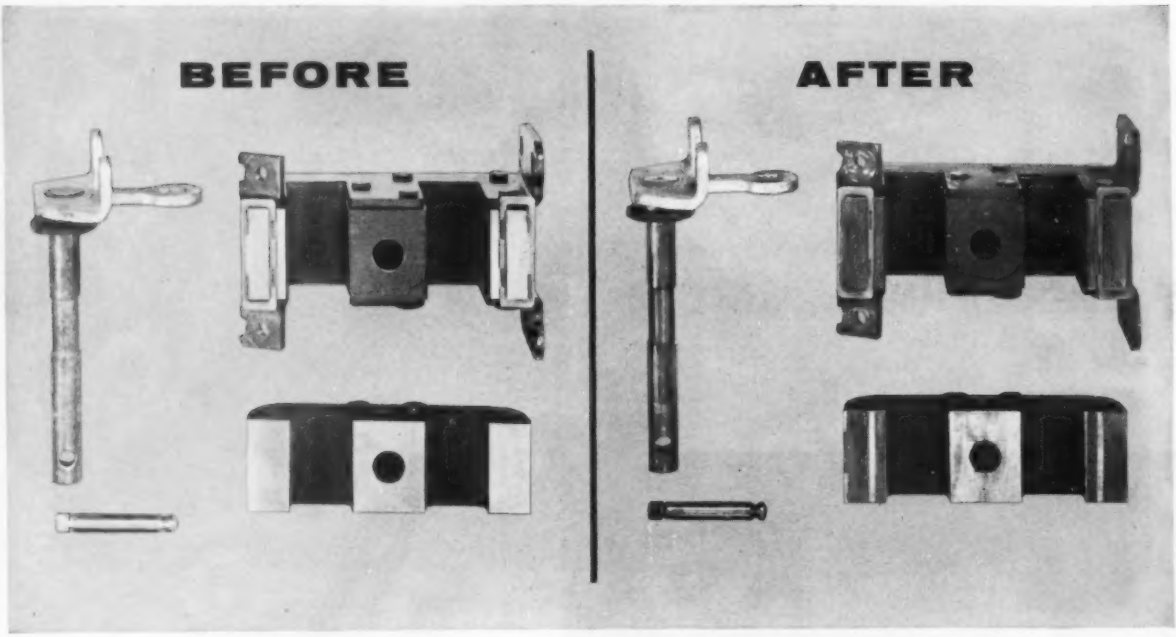
| TYPE "SJO" FLEXIBLE—300 VOLTS | | | | | |
|---|---|---|---|---|---|
| SIZE A.W.G. | STRANDING | TWO CONDUCTOR | | THREE CONDUCTOR | |
| | | Approx. O. D. | Approx. Net Wt. Per M' | Approx. O. D. | Approx. Net Wt. Per M' |
| 18 | 16/30 | .30 | 53 lbs. | .33 | 70 lbs. |
| 16 | 26/30 | .33 | 63 lbs. | .36 | 86 lbs. |

| TYPE "SJO" EXTRA FLEXIBLE—300 VOLTS | | | | | |
|---|---|---|---|---|---|
| SIZE A.W.G. | STRANDING | TWO CONDUCTOR | | THREE CONDUCTOR | |
| | | Approx. O. D. | Approx. Net Wt. Per M' | Approx. O. D. | Approx. Net Wt. Per M' |
| 18 | 42/34 | .30 | 50 lbs. | .33 | 70 lbs. |
| 16 | 67/34 | .33 | 61 lbs. | .36 | 86 lbs. |

*It Costs Less to Buy the Best*

ROME CABLE ROME, N.Y.

ROME CABLE
*Corporation*
ROME · NEW YORK
and
TORRANCE · CALIFORNIA



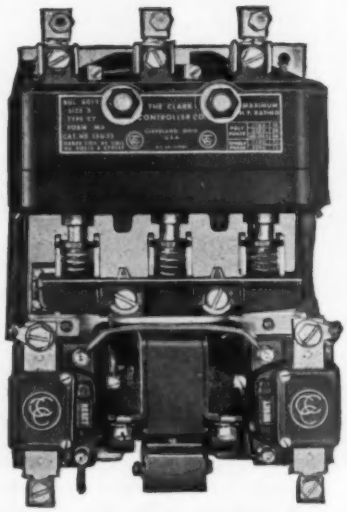

# PROOF OF LONG LIFE OF CLARK TYPE "CY" STARTERS

These unretouched photos show magnet parts of a CLARK Bulletin 7707 Contactor—the contactor used on standard CLARK Bulletin 6013, Size 2, Type "CY" AC motor starters—as they looked before and after nearly 3 years of continuous service. During this time the contactor opened and closed 4 to 5 times per minute, 24 hours per day, 7 days per week—a total well over 5 million operations.

The contactor was in service at Taylor Instrument Companies, Rochester, N. Y., on a "Hevi-duty" molten salt pot electric furnace used for instrument calibration. It was installed *after several contactors of another make had failed in 4 months or less.* Our contactor was still performing perfectly when it was replaced by another identical unit, so that we could study the magnet wear.

All wearing surfaces were carefully "miked" and each dimension compared with the original. As seen in the "before and after" photos, wear was barely apparent to the naked eye. Micrometer readings showed actual wear measurable only in thousandths and ten thousandths of an inch. Only a fraction of the usable life had been consumed.

*Write for descriptive literature.*



**CLARK Type "CY" Starters** *include many more features for dependable service and reduced maintenance. Let us tell you the complete story.*

*The* **CLARK** **CONTROLLER** *Company*

***Engineered Electrical Control***

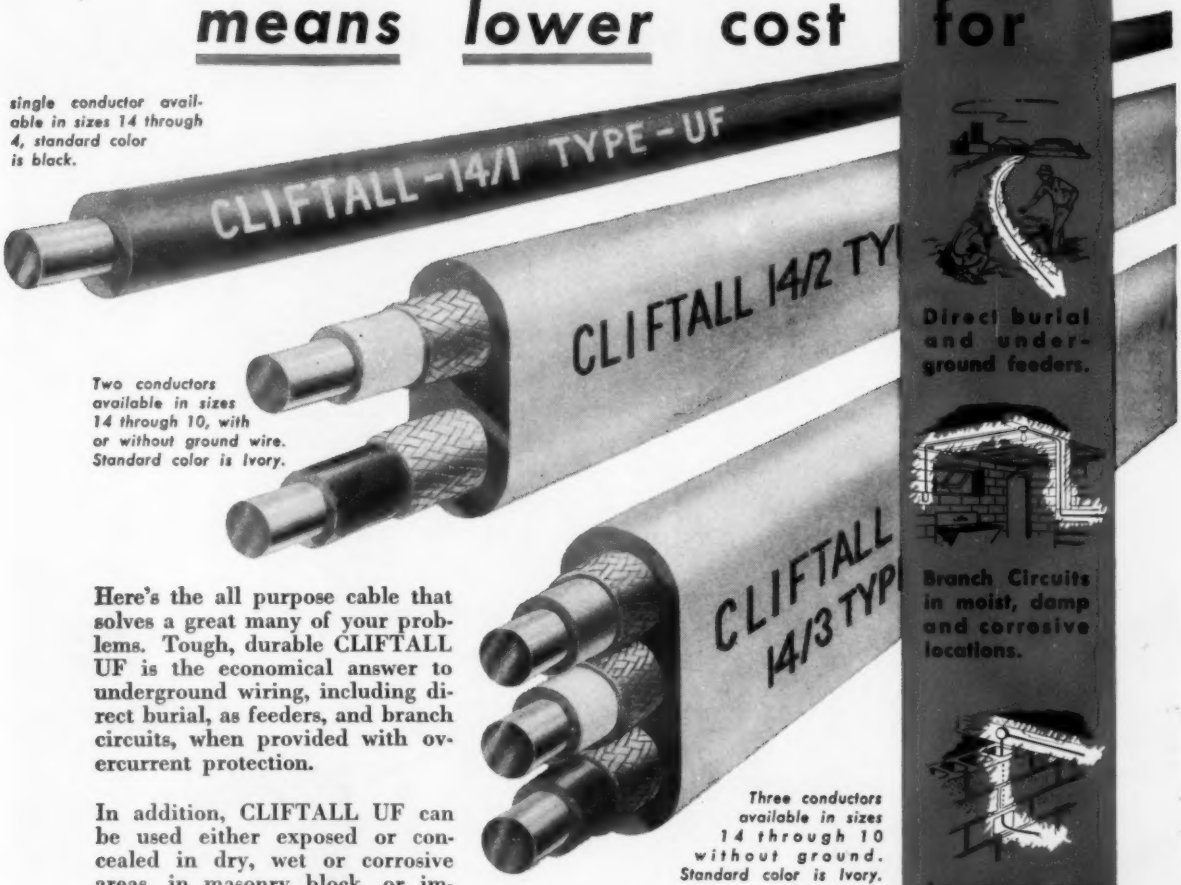
**1146 East 152nd Street • • Cleveland 10, Ohio**

IN CANADA: CANADIAN CONTROLLERS, LIMITED • MAIN OFFICES AND PLANT, TORONTO

# NEW CLIFTALL UF CABLE

## *means lower* cost for

*single conductor available in sizes 14 through 4, standard color is black.*




*Two conductors available in sizes 14 through 10, with or without ground wire. Standard color is Ivory.*

*Three conductors available in sizes 14 through 10 without ground. Standard color is Ivory.*

**Here's the all purpose cable that solves a great many of your problems. Tough, durable CLIFTALL UF is the economical answer to underground wiring, including direct burial, as feeders, and branch circuits, when provided with overcurrent protection.**

**In addition, CLIFTALL UF can be used either exposed or concealed in dry, wet or corrosive areas, in masonry block, or imbedded in plaster.**



**Direct burial and underground feeders.**



**Branch Circuits in moist, damp and corrosive locations.**



**In masonry blocks or wall tiles**

***Also recognized for use as TYPE NMC (non-metallic sheated cable, corrosive resistant.) Section 3362, a and b.***

**In CLIFTALL UF, bare copper conductors are insulated with high quality thermoplastic, color coded for convenience, then covered with reinforced fiber glass. The parallel conductors are then sealed as a unit in high quality thermoplastic that can withstand the most rugged conditions.**

**Approved by Underwriters Laboratories, Inc., and recognized by National Electric Code (1953). CLIFTALL UF is available in sizes 14 to 4 AWG, single conductor only; 14 through 10 in two conductor with and without ground, and 14 through 10 in 3 conductor without ground. Use CLIFTALL UF and be sure!**

*WRITE TODAY For Full Information*

Warehouses Throughout the Country.

*REPRESENTATIVES IN PRINCIPAL CITIES*

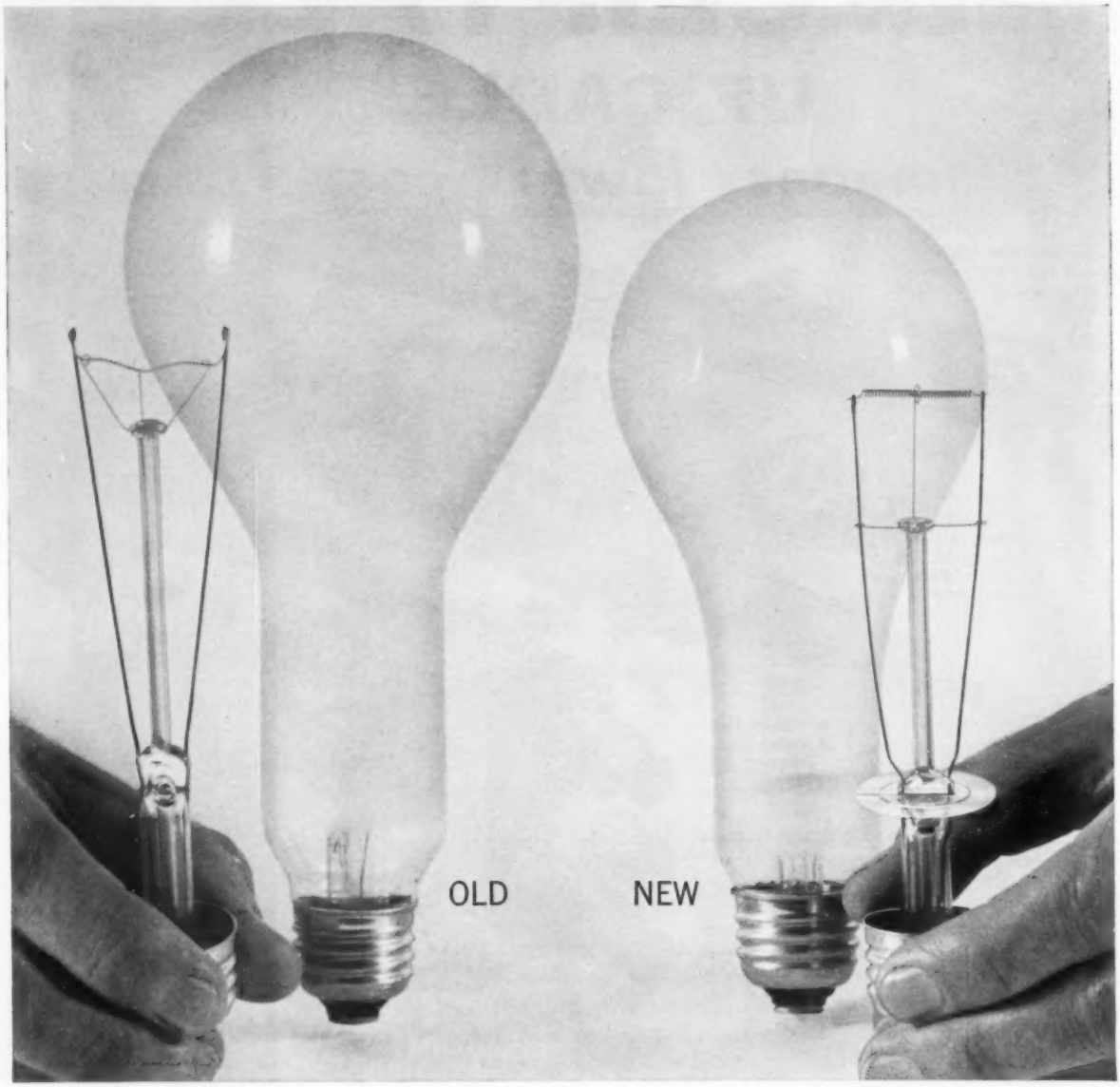
Clifton CONDUIT COMPANY, INC.

**MAIN OFFICE**
75 Montgomery St.
Jersey City 2, N. J.

**FACTORIES**
MEMPHIS
Tennessee
BALTIMORE
Maryland

WIRE—CABLE—RIGID CONDUIT—ELECTRIC METALLIC TUBING—CLIFTALL UF

G-E LAMPS GIVE YOUR CUSTOMERS MORE FOR ALL THEIR LIGHTING DOLLARS




# New General Electric 200-watt bulb takes less space, but gives more light

A NEW General Electric 200-watt bulb, shorter and slimmer than the old one, fits into fixtures and lamps that would formerly take nothing larger than a 150-watt bulb.

The new G-E bulb gives about 3% more light than the old one. In the new bulb, the filament is an efficient *coiled* coil, which needs only one support. The filament of the old bulb is a single coil which needs three fine-wire supports. Although these support the filament firmly, they tend to cool it and slightly reduce the light. Based on average operating costs, the extra light of the new bulb is worth 7¢ to 10¢ over the life of the bulb.

Though the new design puts the hot filament closer to the base, the new General Electric 200-watt bulb is safe to use even in paper-lined sockets. That's because of a heat-reflecting disc of aluminum between the base and the filament.

With all this extra value built in, the new bulbs list at a penny *less* than the old. For more facts on how General Electric gives more for *all* your customers' lighting dollars, write for a 16-page G-E progress report to lamp users. It's free, just write General Electric Company, Dept. 482-EC-7, Nela Park, Cleveland 12, O.

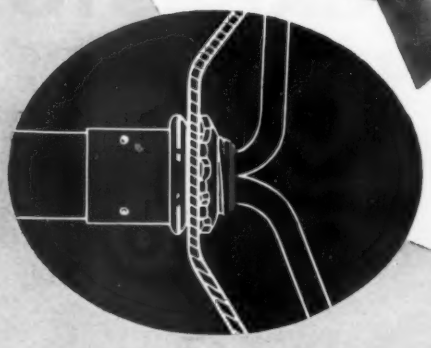
*Progress Is Our Most Important Product*

GENERAL ELECTRIC

# Red Throat

## B-M 21 B, THE NEW INSULATED THROAT INDENTER CONNECTOR FOR E. M. T.

*Four Ways Finer*



1. Protruding rounded red plastic lip of bushing prevents cutting of insulation—eliminates shorts.
2. Full thread screws into all conduit fittings. Lip of RED THROAT bushing protects thread from damage.
3. Deep dished eight pronged lock nut is easier to drive on—screws flush to shoulder and digs into metal of box for vibration proof positive ground.
4. Permanent locked-in bushing insures smooth burr-free raceway for easy fishing. No extra work and costs no more.

Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job!

**ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT**

Order from Your Wholesaler!

All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

Warehouse Stocks in Principal Cities for Immediate Delivery!

# MILLIONS OF FEET NOW IN SERVICE

## BECAUSE OF PROVED PERFORMANCE

**ROCKBESTOS**
**PNR** SMALL DIAMETER CONTROL CABLE

There are still a few who haven't yet taken advantage of PNR . . . the lighter, smaller control cable. But it's come a long way since we first introduced its Polyethylene, Nylon, Rockhide insulation to industry just six short years ago.

Today, many utilities specify it. And there are millions of feet in service.

If you haven't tried it yet, get the complete PNR story today. Write or ask your nearest Rockbestos representative.

*Average determined by comparison with conventional control cable.

**PROPERTIES OF PNR**

46% smaller in area* . . . 28% smaller in diameter* than conventional control cable.
Use smaller conduit and fittings or put more conductors in existing conduit.
Lighter, easier to handle, store, ship, pull through conduit.
Dielectric breakdown . . . over 40 times operating voltage.
Rated 600 volts . . . conductor operating temperature 167°F.
Flexible from 167° to —67°F.
No cracking!

**ROCKBESTOS PRODUCTS**
**NEW HAVEN 4, CONN.**

**CORPORATION**
NEW YORK • CLEVELAND • DETROIT
CHICAGO • PITTSBURGH • ST. LOUIS
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# Qwik Change

with **PACKAGED Motor Starter PARTS!**

## *New* PUSH BUTTON KIT

**OTHER KITS...**

- Selector Switches
- Interlocks
- Replacement Parts
- Contacts
- Coils
- Overload Relays

**EASY to Identify!**

Easy-to-read catalogs, simplified motor control and overload relay selectors, illustrated service bulletins...these all combine to assure *quick changes* through easy parts identification.

**EASY to Buy!**

Conveniently packaged and labeled conversion parts are immediately available "off-the-shelf" from nationwide network of authorized SquareD electrical distributors.

**FASTER to Install!**

Conveniently packaged parts can be installed using only a screw driver and without disturbing any wiring.

*Write* for Bulletin 9999. Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

**SQUARE D COMPANY**

# . . . with SYLVANIA
# King-Size, High-Output Lamp

Now here's the fluorescent lamp that offers *more light output than ever before from a single fluorescent lamp*—in the new Sylvania 96", T-12, 100-watt Rapid Start lamp.

Providing as much as 40% more light output than previous 8-foot lamps—this new Sylvania lamp can bring you important installation and maintenance savings.

With this new Sylvania lamp you can now make a two-lamp fixture do the work of a three-lamp fixture . . . for economies when you put them up . . . economies every time you maintain lamps.

For information on this new Sylvania development, write Department 5L-2407.

SYLVANIA ELECTRIC PRODUCTS INC.
Lighting Division, Salem, Massachusetts
*In Canada: Sylvania Electric (Canada) Ltd.*
*University Tower Building, Montreal*

**SYLVANIA®**

**. . . fastest growing name in sight**

**LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY**

*New pier for a busy seaport...*

# WIRE BY PHELPS DODGE

*. . . Unusual construction calls for aerially-installed cable with submarine-type insulation!*

New York City's new 12-million-dollar Department of Marine and Aviation Pier 57 is one of the most modern in the world—and so is its wiring system.

A unique feature of the system is a cable with submarine-type insulation, installed aerially without physical protection of any kind. This installation offers most of the advantages of a conduit system at a far lower cost. The cable can withstand varying temperatures estimated from minus 10 degrees Fahrenheit to 130 degrees Fahrenheit and humidity up to 100%.

This cable was designed and tested to meet the special requirements of the Dept. of Marine and Aviation, City of New York, including U. S. Coast Guard specifications for submarine-type cable.

All of the wire and cable for the pier was supplied by Phelps Dodge.

On every wiring job, large or small, where top quality materials, expert workmanship and experienced "know-how" are called for, *it pays to rely on Phelps Dodge and your Phelps Dodge distributor!*

**PHELPS DODGE COPPER PRODUCTS CORPORATION**

**SALES OFFICES:** Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Roanoke, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

# $ensible $aving

is the smart reason for the 20 ft. length of these rolls. You get this size in the 10-roll container of *Gold Seal* Plastic Tape. For companies that supply tape to many workers for varied jobs, it's the best buy. "Tape-saver" size, we call it. It's enough for the average job . . . footage of "lost" tape is kept low. Workers like the small size, too. It "swings" easy in tight places. And remember, you start saving the minute you say

## GOLD SEAL
## plastic tape

It gives you the many plastic tape advantages, with the plus of proved Gold Seal quality. With the warranty of Jenkins Tape specialists, you can be sure it will speed the job, stick right, and stand up under toughest conditions. Try it . . . sample free on request. Jenkins Bros., Rubber Division, 100 Park Ave., New York 17.

Gold Seal Plastic Tape — single 60 ft. rolls in round metal cans and Handy Pack of ten 20 ft. rolls.

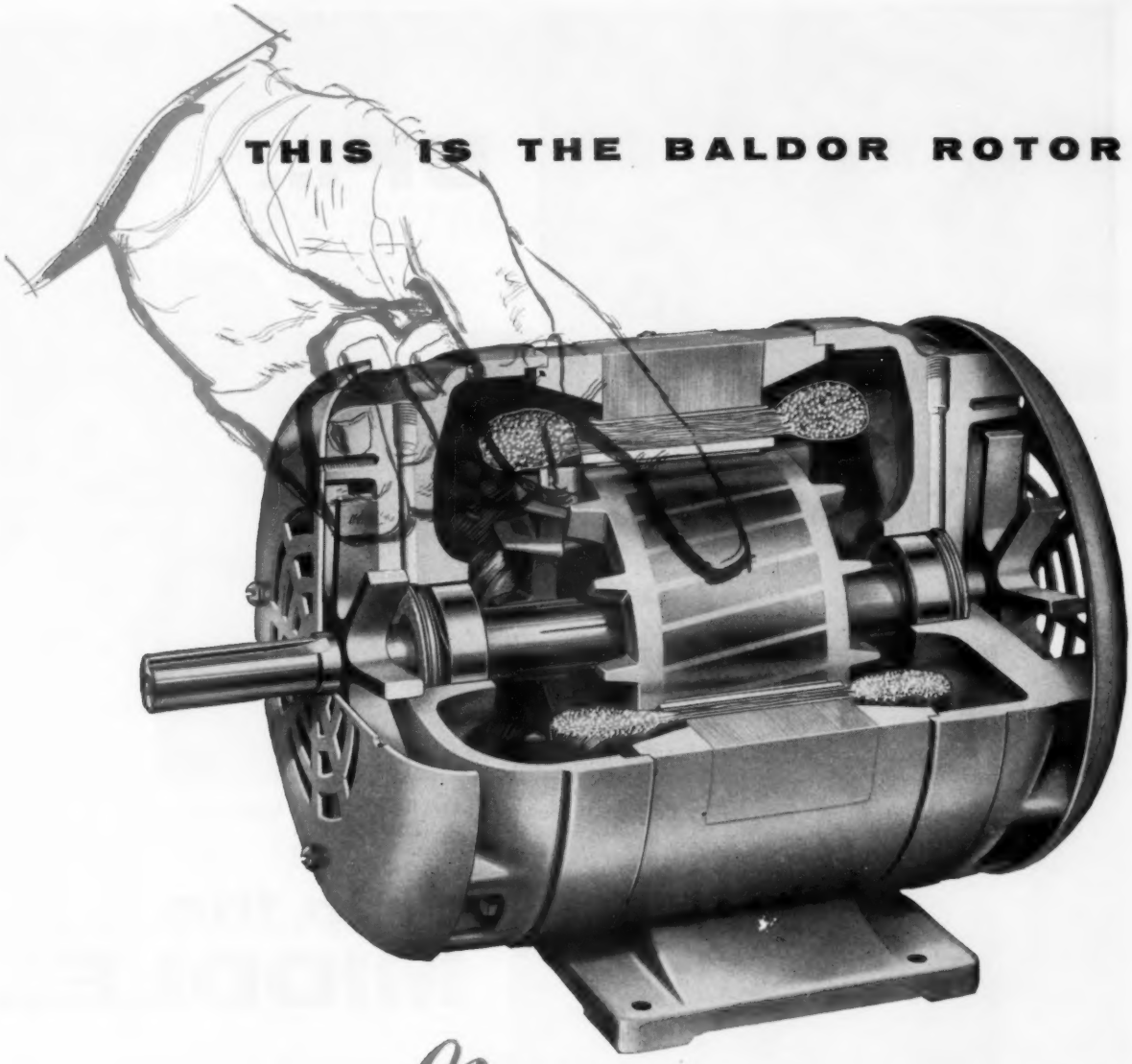
**JENKINS**

*Gold Seal Tape*

**FRICTION • RUBBER • PLASTIC**

Single rolls and 10-roll containers. Also Diamond Seal Friction and Rubber Tapes made to ASTM Specifications. Products of Jenkins Bros. — makers of famous Jenkins Valves.

# THIS IS THE BALDOR ROTOR



## CONTAINED IN THE *New* BALTRIC LINE

The rotor is the very heart of any electric motor, and the Baltric Motor contains the heart of a champion. Advanced engineering and improved techniques mark the entire Baltric line of completely enclosed motors which have achieved a rotor with less noise . . . better balance.

The new Baltric Motor is designed and built to attain the utmost in stamina and performance with less bulk and less weight. Baltric Motors can be engineered to meet your special mechanical and electrical requirements. Remember . . . they are totally enclosed, *Streamcooled* . . . your Best Buy is Baltric!

BESS-2

**Original *Streamcooled* Baldor Motors Available — Built to Former NEMA Standards**

**BALDOR ELECTRIC COMPANY**

*Baltric Motors Are Available in Polyphase • Squirrel Cage • Induction and Single Phase • Capacitor Start • Induction Run Types*

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When good stretch and adhesion are required . . .

# UP...

# DOWN...

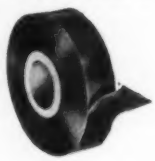
When the need is for thin splices that leave wiring neat and uncluttered . . .

When the splicing has to be done in confined spaces . . .

# or in the MIDDLE..

## the best splices are made with U. S. Royalastic Tape

This plastic tape does the work of both rubber *and* friction tape on many jobs. It lets a man do a fast, nimble job of splicing in jammed-up spaces. *Complete mechanical and electrical protection.* Good tensile strength and high resistance to abrasion and to water, oils, acids, alkalies, corrosive chemicals. Good stretch and adhesion. Approved by Underwriters' Laboratories, Inc. Order *dependable* U. S. Royalastic Tape from a selected "U. S." Distributor or from any of the 27 "U. S." District Sales Offices.



*"U. S." Research perfects it..."U. S." Production builds it...U. S. Industry depends on it.*

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**MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.**

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

**Commander Mills, Inc., Sand Springs, Oklahoma**

***Chief Electrician, Wm. Bert Peacock, Speaking . . .***

## "Protecting motors with FUSETRON fuses is saving us about $6000.00 per year."

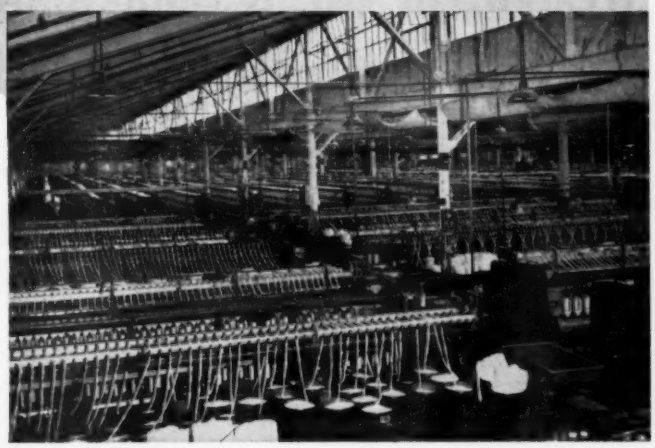
"We have 1000 looms, 90 of which are powered by 1 hp motors, 180 by 1½ hp, 100 by ½ hp, 630 by ¾ hp. Prior to 1949 several hundred of these were rewound each year.

"We started using Fusetron Fuses in the winter of 1949 and began to keep individual records on motors. The reduction on motor burn-outs was immediately noticeable.

"There is no way of knowing, but it is my belief that some motor repairs now are due to partial damage done prior to 1949.

"In the entire plant we have over 2,500 motors, representing a little more than 5,000 hp connected load. The following list shows our actual expenses on motor repairs."

| YEAR OF REPAIRS | NUMBER OF MOTORS | AMOUNT |
|---|---|---|
| 1949 | (No record kept) | $6,804.00 |
| 1950 | 87 | 2,796.20 |
| 1951 | 59 | 2,640.44 |
| 1952 | 63 | 2,165.63 |
| 1953 (1st 6 mos.) | 23 | 445.84 |



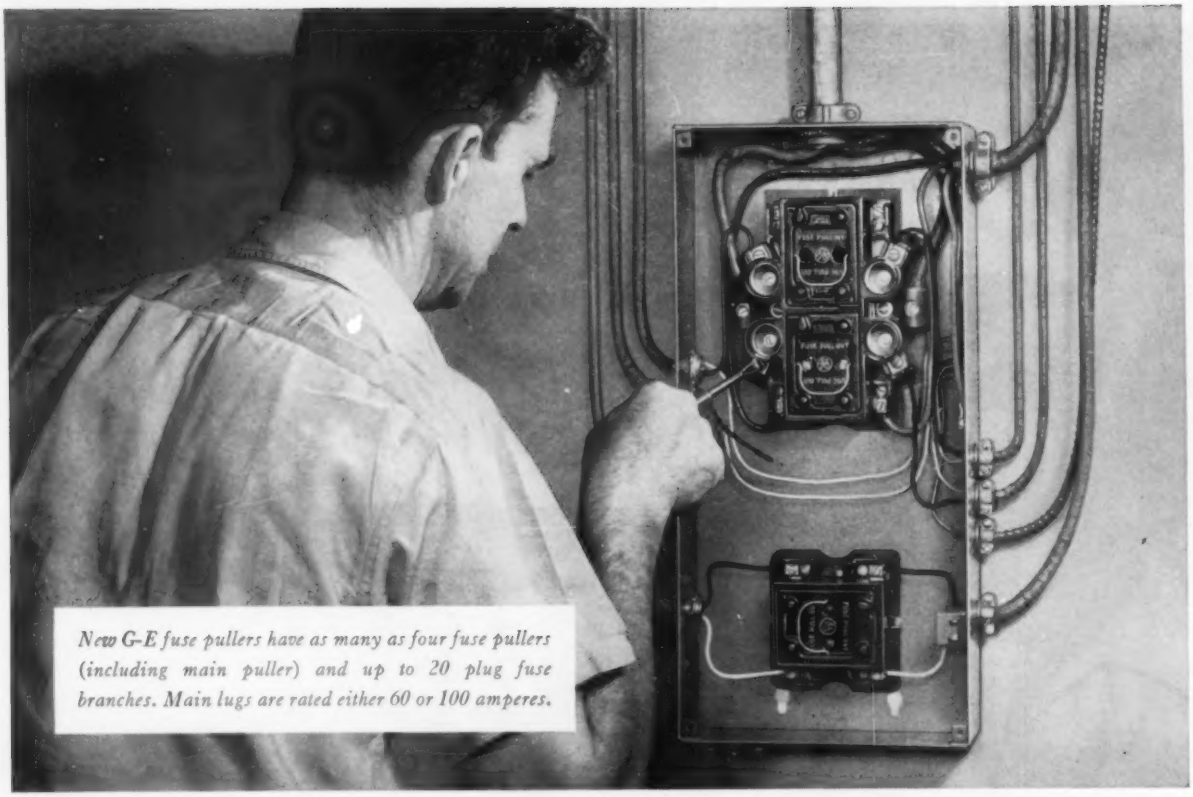
## FUSETRON fuses do more than protect motors—they give you 10 point protection.

1 *Protect against short-circuits.
2 Protect against needless blows caused by harmless overloads.
3 Protect against needless blows caused by excessive heating—lesser resistance results in much cooler operation.
4 Provide thermal protection—for panels and switches against damage from heating due to poor contact.
5 Protect motors against burnout from overloading.
6 Protect motors against burnout due to single phasing.
7 Give DOUBLE burnout protection to large motors—without extra cost.
8 Make protection of small motors simple and inexpensive.
9 Protect against waste of space and money—permit use of proper size switches and panels.
10 Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York.

FUSETRON — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — BUSS

**BUSSMANN MFG. CO.** *(Division of McGraw Electric Co.)* University at Jefferson, St. Louis 7, Mo.



*New G-E fuse pullers have as many as four fuse pullers (including main puller) and up to 20 plug fuse branches. Main lugs are rated either 60 or 100 amperes.*

# Straight-in wiring and slide-out interiors in new G-E fuse pullers simplify job from start to finish

**7 fusible devices offer 7 quality extras at no extra cost**

**1. Straight-in wiring** for quick connections. No looping wires around screws, just insert and tighten. Grips like a bear trap.

**2. Exclusive slide-out interior** gives plenty of working room. No screws to fumble with or lose. Interior slides in and out with perfect alignment.

**3. Narrow, shallow box** construction makes it easier to mount box flush with wall. A G-E exclusive.

**4. Plenty of easily removed knockouts** make it simple to bring cable into box at most convenient place.

**5. Current-carrying parts are silver-plated** for cool operation, won't waste electricity. A G-E exclusive.

**6. Snap-action fuse puller** prevents partial contact. Exclusive construction helps prevent overheating, nuisance fuse failure and call backs.

**7. Bonderite* finish** resists corrosion; protects against rust. Another G-E exclusive.

**New G-E fuse pullers have 60 or 100 amp. main lugs.** Seven basic designs include series or parallel wiring and sealable pullers for separately metered equipment. U/L listed. Surface or flush mounted designs. Ready for quick delivery from your G-E Trumbull Distributor.

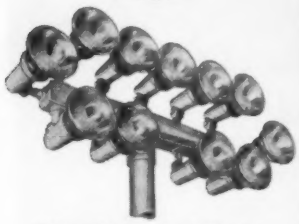
*Parker Rust Proof Co.

GENERAL ELECTRIC

# Stonco

## VAPORTIGHT FIXTURES

*See your Stonco Distributor for —*



**Cluster Lighting**
*...a complete line*

**Super Spots**
*...a complete line*

**Lamp Holders**
*...a complete line*

**Plus** — a full line of island lights, yard lights and other floodlighting fittings and fixtures.

## *Stay Cooler! Cleaner! Brighter!*

**Cooler —** because they're practically air conditioned! Continuous reflector vents encircle the entire fixture forcing a constant stream of circulating air through the fixture and out. Fixture stays cooler, lamp burns cooler, more efficiently, lasts longer.

**Cleaner —** because the moving air stream sweeps dirt and dust out through the vents. Keeps grime deposits off the reflecting surface. Reflector stays cleaner *longer,* maintains peak reflecting efficiency longer and — reduces maintenance and cleaning to a minimum.

**Brighter —** because Stonco reflectors are lifetime vitreous porcelain-enamel that is literally glass-fused-to-steel in a permanently brilliant white that stays white longer. It *can't* corrode, scratch, fade, or deteriorate. Needs only occasional soap and water cleaning to keep at top reflecting efficiency.

*That's why* – Stonco gives you top value in Vaportight fixtures and offers you—through your Stonco Distributor—a dependable source of supply for fixtures designed and engineered to lead the industry in value and performance.

**Stonco Floodlighting**

S-162

STONCO ELECTRIC PRODUCTS COMPANY, KENILWORTH, NEW JERSEY

15 AMP. 125 V.

| | |
|---|---|
| POWER OUTLETS | No. 5261 Single, Flush — No. 5281 Single on 4" Cover<br>No. 5284 Single, Short Yoke — No. 5282 Duplex on 4" Cover<br>No. 5262 Duplex, Flush — No. 5260 Weatherproof, Flush |
| CAPS | No. 5263 Plastic<br>Nos. 5264 & 5265, Armored with Cord Grip<br>Nos. 5266 & 5267, Rubber with Cord Grip |
| CONNECTORS | Nos. 5269 & 5270 Plastic, Armored with Cord Grip<br>No. 5294 Rubber with Cord Grip |

15 AMP. 250 V.

| | |
|---|---|
| POWER OUTLETS | No. 5661 Single, Flush — No. 5684 Single, Short Yoke<br>No. 5662 Duplex, Flush |
| CAPS | No. 5663 Plastic<br>Nos. 5664 & 5665, Armored with Cord Grip<br>Nos. 5666 & 5667, Rubber with Cord Grip |
| CONNECTORS | Nos. 5669 & 5670 Plastic, Armored with Cord Grip<br>No. 5694 Rubber with Cord Grip |

## For New Safety in Portable Equipment Connections . . .

# Here's A Full Line of Bryant Quality Grounding Devices

In compliance with National Electrical Code Paragraphs 2123-b, 2124-b, 2545, 2559, 2560, 4010

20 AMP. 250 V.

| | |
|---|---|
| POWER OUTLETS | No. 9326 Single, Flush<br>No. 9324 Single, on 4" Cover<br>No. 9325 Single, Surface |
| CAPS | No. 9322 Armored with Cord Grip<br>No. 9320 Rubber with Cord Grip |
| CONNECTORS | No. 9323 Plastic, Armored with Cord Grip<br>No. 9321 Rubber with Cord Grip |

30 AMP. 250 V.

| | |
|---|---|
| POWER OUTLETS | No. 9303 Flush (Nos. 9301 and 9302 Plates)<br>No. 9304 Surface in Aluminum Enclosure |
| CAPS | No. 9331 Plastic<br>No. 9337 Metal Covered with Cord Grip |
| CONNECTOR | No. 9341 Composition with Armored Cord Grip |
| CORD SETS | No. 9339 with Non-Removable Rubber Cap<br>Available in 36, 48 & 60" Lengths |

50 AMP. 250 V.

| | |
|---|---|
| POWER OUTLETS | No. 3846 Flush with Plate<br>No. 3926 Surface with Aluminum Enclosure |
| CAPS | No. 3833 Plastic<br>No. 7513 Plastic with Cord Grip |
| CORD SETS | No. 3899 with Non-Removable Plastic Cap<br>No. 3830 with Non-Removable Rubber Cap<br>Both in 36, 48, 60 and 72" lengths |

BRYANT

SUPERIOR WIRING DEVICES

*For complete listings, write to*

**THE BRYANT ELECTRIC COMPANY**

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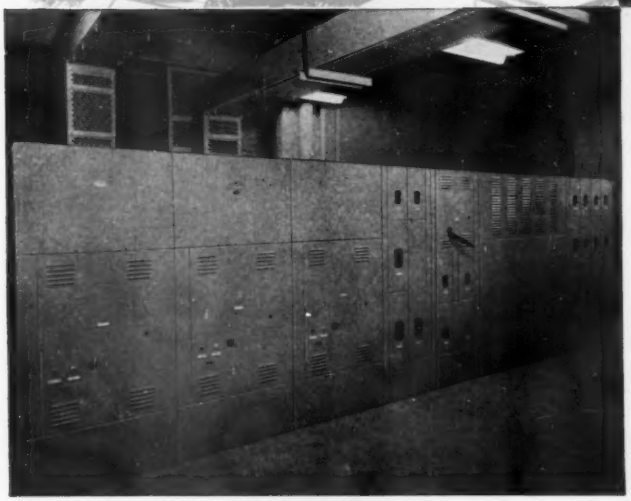
# production speeded at Clothcraft plant



Joseph and Feiss Manufacturing Company of Cleveland, Ohio, makers of men's clothes, recently installed FA High Efficiency Feeder Busduct and unit sub-stations in its Clothcraft plant.

Like many others, the company found that this new and modern system of power distribution added substantially to the efficiency and flexibility of plant operations, and provided large savings by reducing power losses to a minimum.

The reason is simple: FA High Efficiency Feeder Duct is the last word in efficient, flexible and economical power distribution from service entrance to distribution center, from transformer to switchboard or from switchboard to distribution center.

Made in standard lengths that fit readily together FA High Efficiency Feeder Duct can be used either indoor or outdoor. Sections can be run vertically or horizontally, up and around pipes and other obstructions and through walls and floors.

Enclosures are light in weight and have perforated sectional covers — top and bottom — for maximum heat dissipation.

FA High Efficiency Feeder Busduct is available in capacities from 600 to 4,000 amps, 600 volts single phase for welder service, three phase for power and three phase, four-wire service for power and light distribution.

For further information about this new and better system of power distribution consult your nearest FA representative listed in Sweet's.

with FA

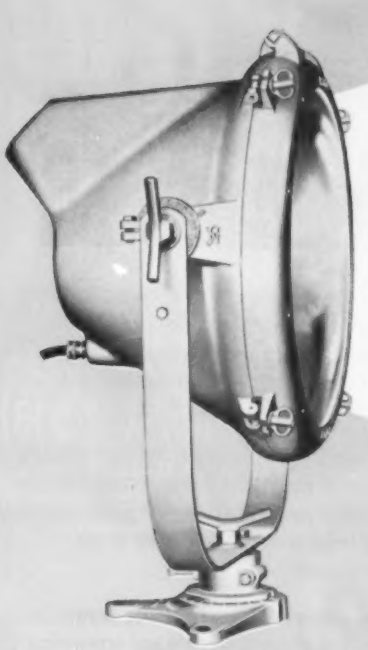
# HIGH-EFFICIENCY FEEDER BUSDUCT

*Frank Adam Electric Co.*

Phone JEfferson 3-6550
BOX 357, MAIN P. O. • ST. LOUIS 3, MO.

*makers of:*
*busduct • panelboards • switchboards*
*service equipment • safety switches*
*load centers • Quikheter*

# Still on the job . . . AFTER 30 YEARS!



New 20" Floodlight, Type 20175

## PYLE-NATIONAL Enclosed Cast Aluminum

# FLOODLIGHTS

Pictured above is a night view of the Wrigley Building, Chicago, one of the early installatons of Pyle-National floodlighting. The original lights are still on the job even after having been loaned to the Navy during the war. When reinstalled, total cost of replacement parts was less than $2.00!

This is a remarkable example of the long-range *economy* and *efficiency* you can expect from high quality enclosed aluminum floodlights.

Fourteen models to serve every need.

- WATER-TIGHT
- DIRT-TIGHT
- CORROSION-PROOF
- HIGH EFFICIENCY
- LOW MAINTENANCE

Literature furnished on request.

SINCE 1897

## THE PYLE-NATIONAL COMPANY

WHERE QUALITY IS TRADITIONAL

1344 North Kostner Avenue, Chicago 51, Illinois

District Offices and Representatives in Principal Cities of the United States • Canadian Agent: The Holden Co., Ltd., Montreal
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PLUGS AND RECEPTACLES • CIRCUIT CONTROLS • LIGHTING FIXTURES • CONDUIT FITTINGS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

54th Year —JULY • 1955

# Can We Learn from Modernization?

**Revision upwards** of the expected 1955 construction volume by Department of Commerce analysts at midyear confirms, at the national level, the objective evidence apparent in almost every community of a very busy building construction industry. A new record is in the making.

**New construction is a good,** firm market for the electrical industry. Every building project provides at least a minimum complement of electrical work. Most, in these days of rapid electrical progress, will be designed well above minimum requirements. But are these new systems capable of growth or are we building in rewiring problems for some future date?

**Paralleling the new construction boom** is the now desperate need for electrical modernization of existing buildings. The electrical systems in these structures were, in their day, satisfactory, even exemplary. They were capably designed and installed according to the then prevailing practices and standards of the industry. But expensive additions in electrical capacity are urgently needed to permit normal occupancy today.

**What we are learning in modernization** ought to be influencing new construction. But is it? The specifics are available to anyone from the current drawings and blue prints he is working on. The chances are that the electrical system is designed essentially for the *initial* loads and communications planned.

**Is contemporary practice freezing-in** a rewiring crisis for 1965 or '70? Probably. But it need not be as critical or expensive as that faced by owners of buildings now 20 or 30 years old. The bottlenecks are raceway capacity and equipment space. This is the lesson of current modernization. Both are inexpensive in original installations. Both are extremely costly in later modernization.

**In busy times** there is a natural dilution of creative selling effort. There are limits to the time and energy of the comparatively few in engineering and electrical contracting who are gifted with the ability to see beyond immediate needs and who have the talent to get their proposals across to customers. But the present situation is crucial. And the objectives deserve our full ability.

**Oversize conduits, spares and equipment space** would mean more business immediately. But more importantly they will give access for future expansion in electrical work that could be permanently sealed off by shortsighted design and opportunity over-looked today.

Wm. T. Stuart

**POWER . . . WHERE POWER PAYS OFF.** No matter how tough or how special the conditions, Graybar-distributed G-E motors and controls give you full overload protection, guard against physical damage, electrical breakdown and operating wear.

# How to cut down-time . . . step up production

## SEND for your FREE copy!

Here in capsule form are the features of the new G-E Tri/Clad '55' motor — its new insulation system . . . new bearing system . . . new ventilating system. See for yourself how better performance and easier maintenance features will save your customers money year in . . . year out.

Here are two practical suggestions: *the first* gives your customers maximum defense against shutdown due to motor failure; *the second* insures reliable nonstop production shift-after-shift.

**1. NEW, G-E TRI/CLAD '55' MOTOR** — via Graybar. This all-new G-E Motor is built to last longer, perform better. New compact dripproof, rust-resistant cast-iron construction . . . new water shedding silicone stator windings . . . new stronger polyester film insulation . . . higher full load speeds . . . longer bearing life without regreasing.

**2. GRAYBAR'S SPECIAL SERVICE ANALYSIS.** Do your service conditions demand totally enclosed motors? Variable speed? Gear or reversible? A Graybar Power Apparatus Specialist will work with you in selecting the exact equipment for any machine-drive requirement. Call on him. It will pay off in longer, trouble-free performance. Remember, Graybar distributes the *complete* line of G-E motors and controls.

As a matter of fact, your local Graybar Representative can provide practical application data on more than 100,000 different electrical items. For wiring projects, for instance; or lighting, ventilation and communication; complete information is as near to you as your telephone. 43/-47

***CALL GRAYBAR FIRST FOR...***

GraybaR ELECTRIC CO., INC.
420 Lexington Ave., New York 17, N. Y.

GraybaR *Everything Electrical*

IN OVER 110 PRINCIPAL CITIES

ELECTRICAL CONSTRUCTION AND MAINTENANCE

# WIRING REVOLUTION . . .

## *In A Cocked Hat*

**Reminiscent in appearance of a Colonial tri-cornered hat, M.I.T.'s new dome-shaped auditorium contains an electrical system which includes a special low-decibel transformer, scores of flexible connections and dimmer-controlled fluorescent lighting. Wired by Hixon Electric of Boston, this structure suggests the shape of things to come.**

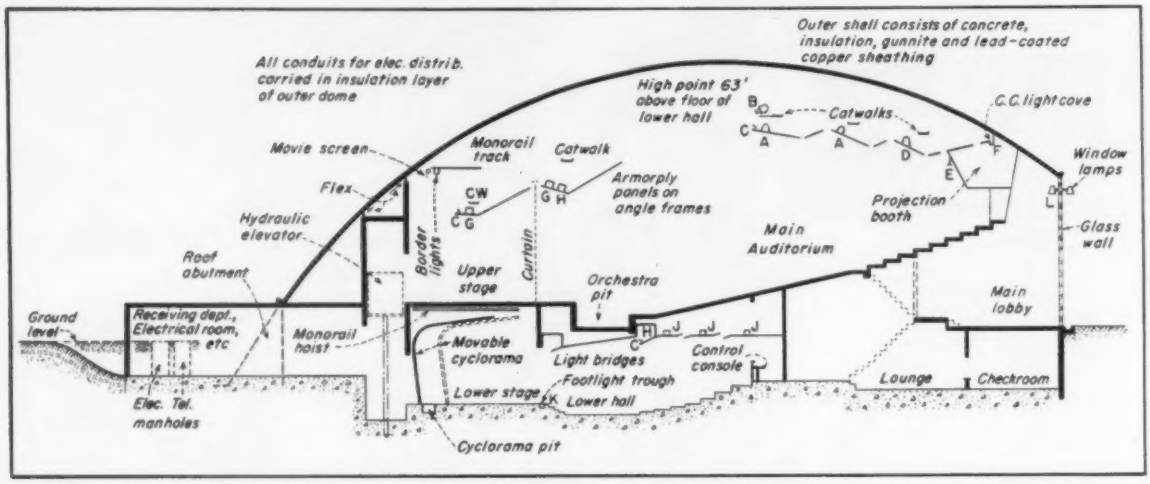
**THREE-CORNERED HAT** is suggested by shell's shape. Shown here is completed laminated wooden formwork prior to placement of reinforcing steel, concrete and sheathing.

**By Hugh P. Scott**

NEWEST structural unit to be erected on M. I. T.'s impressive campus at Cambridge, Mass., is a unique auditorium building which may well influence future concepts of design in both architectural and electrical fields. Of shell construction, the roof surface forms one-eighth of a sphere and, although the weight of the dome exceeds 300 tons, it is supported by only three slender pedestals. Reminiscent in appearance of a Colonial cocked hat, the dome proper terminates in massive edge beams that arch upwards and outwards from the three bearing points, with free-standing vertical plate glass curtain walls arising to meet these arches along continous expansion joints.

Within the structure are two auditoriums, one above the other; the main hall containing 1200 seats arranged in concentric circular lines around a huge stage and orchestra pit, and the smaller hall beneath it seating 200 persons around a smaller but equally well equipped cyclorama-backed stage.

Since the rear of the main auditorium cantilevers out over the lobby, since the projection booth arches up and out above the rear auditorium, since exterior glass curtain walls are independent of the dome (to permit a winter-summer expansion range of 1½ inches), and since all building components incorporate segments of spherical triangles, the routing of feeders and branch circuits created numerous installational complications.




**REVOLUTIONARY CONSTRUCTION** of new MIT auditorium combines spherical concrete dome supported by three bearing pedestals, free-standing glass curtain walls, upper and lower halls and stages, variety of flexible connections and expansion joints, extensive specially-designed lighting fixtures and numerous other outstanding electrical features. Lettered lighting units are detailed on page 73.

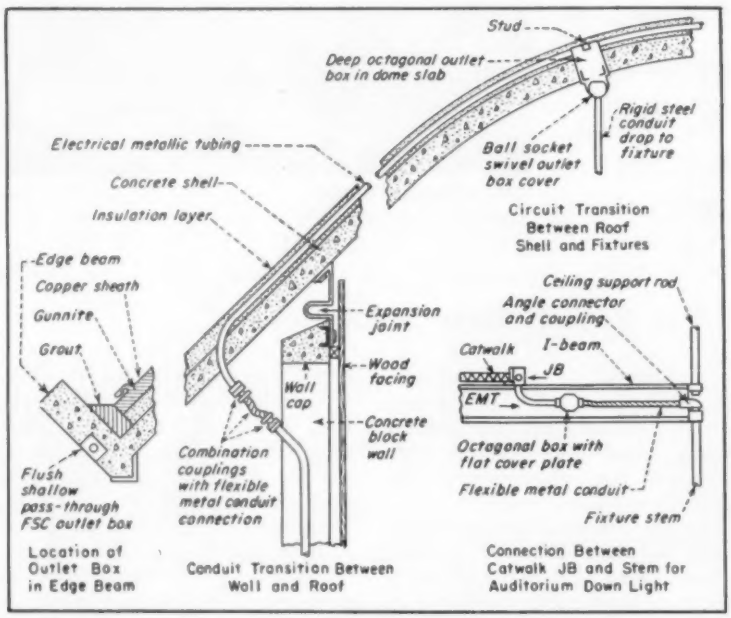
# Complicated Circuiting

Routing of cables is complicated. For example; conduits carrying circuits for ceiling lighting are first carried up structural curtain walls to expansion joints directly beneath the dome. They are then carried through the reinforced concrete shell to a second (insulation) roofing layer where they radiate to various re-entry points in the upper dome. Here they are stubbed downwards again, but are hidden from view from below by a series of suspended acoustical "clouds". These clouds serve as reflectors of sound, create a high level of distribution, yet also serve to support air conditioning ducts, dimmer-controlled fluorescent lamps for varying sky-brightness effects, plus flood- and spot-lighting units for illuminating the stage and orchestra pit. Above the clouds there is also an extensive cat-walk system, with loud speaker and microphone stations, telephone facilities and headphone jacks for the use of electricians.

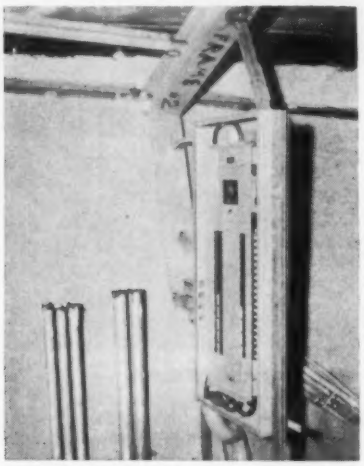
In running the conduit over the concrete shell, each length of pipe had to be bent so as to conform with the curvature of the dome, and all conduits were secured to the concrete by means of bolts and studs driven into the shell by powder-activated guns.

Another example of unusal circuiting and connection is found along edges of the roof dome, where conduits for exterior lighting fixtures are run concealed in the structural beams, and where deep outlet boxes and flush-mounted conduit bodies are installed at each luminaire location. Since these outlets are in the dome, and since the luminaires they serve are secured to the framing of free-standing glass walls beneath, conections between these non-unified building segments are effected through heavy galvanized and weatherproofed steel covers, plus short lengths of flexible cable.

The framing of these window walls is also used to enclose circuits serving fixtures designed for both indoor and outdoor illumination of a brick-paved lobby that extends through the ¼-in. plate glass walls to a spacious exterior terrace.

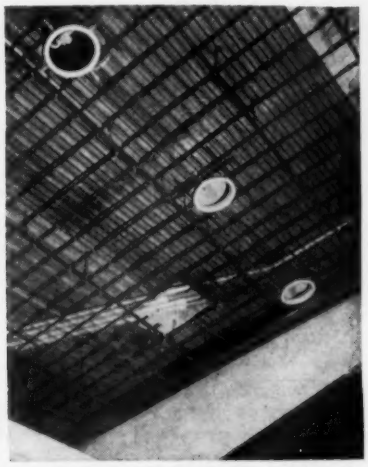



**DISTRIBUTION SYSTEM,** for lighting and electrical services located in upper part of dome, is installed in the insulation layer of the spherical roof shell, with flexible connections and ball-socket swivelling outlets to insure vertical drops.



**CURVED SURFACES** of exterior shell, walls, partitions, acoustical baffles and auditorium cantilever sections necessitated extensive bending of conduits to exact shapes and special mounting arrangements for equipment; as indicated by this projection-booth panel supported to angle braces welded to inclined roof and wall beams.

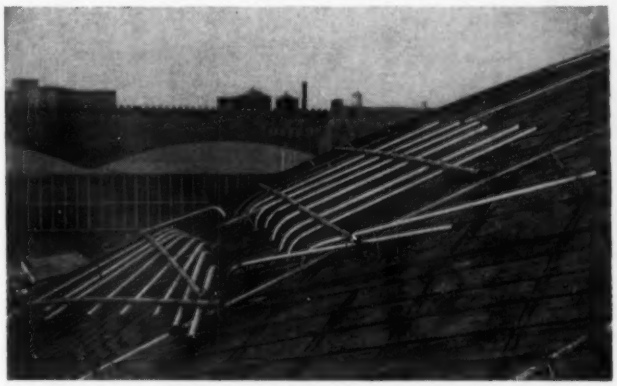
**CANTILEVER CONSTRUCTION** of rear auditorium above lobby, plus details of free-standing exterior glass curtain walls, numerous expansion joints and arched ceiling, dictated circuitous routing of circuits in numerous instances. Mounting of conduits close to slabs was necessary due to streamlined features of finished surfaces.



**TO ILLUMINATE FRONT LOBBY** of auditorium, recessed downlights are incorporated in overhanging balcony slab, and special luminaires are also suspended both inside and outside of glass curtain wall. Features of design and construction made direct point-to-point routing of circuits impossible, while space limitations demanded exact placements.

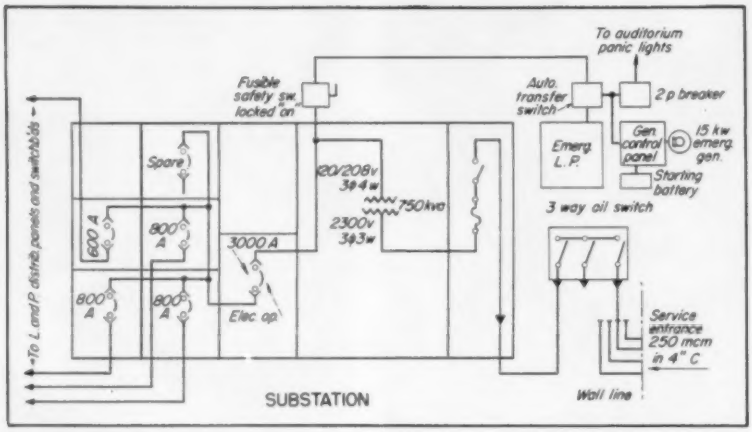
All of these examples indicate that, due to the unusual shape and construction of the building, cable runs are frequently longer than normally anticipated, in many instances being installed circuitously rather than with crow-flight directness between panels and utilization points.

Strikingly different in engineering fundamentals, this building is attracting wide-spread attention, since its colored sky effects, unobstructed vision from all seats, excellent acoustical properties, many electrical facilities and complete air conditioning system make it one of the most modern auditorium structures in the country. In fact, the air conditioning system furnishes yet another illustration of practical planning, for the same refrigeration installation which cools the air in the auditoriums during the warm months of the year will also freeze ice on a contemplated hockey rink during the winter. This refrigeration system is complete, from ammonia compressors and evaporation condensers to high-low pressure cut-outs, oil pressure differential switches, fan and pump mercoid controls, and numerous electric local-area temperature regulators. Also related to the overall air conditioning installation are supply fans, inlet dampers, auxiliary heating and cooling coils, de-humidifiers, electrostatic air filters, remote controls with pilot light status indicators, and exhaust fans.

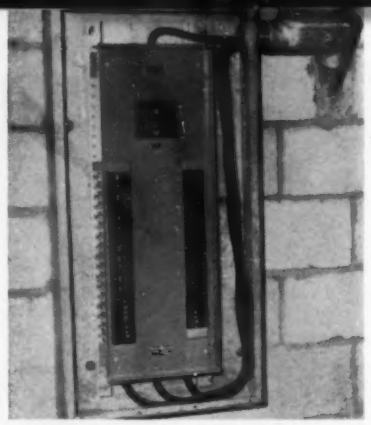


**ELECTRICAL CIRCUITING** for lighting fixtures and motorized equipment located high above auditorium seats was obtained by placing conduits in roof's insulation layer. Wall-to-roof connections for these circuits are flexible.

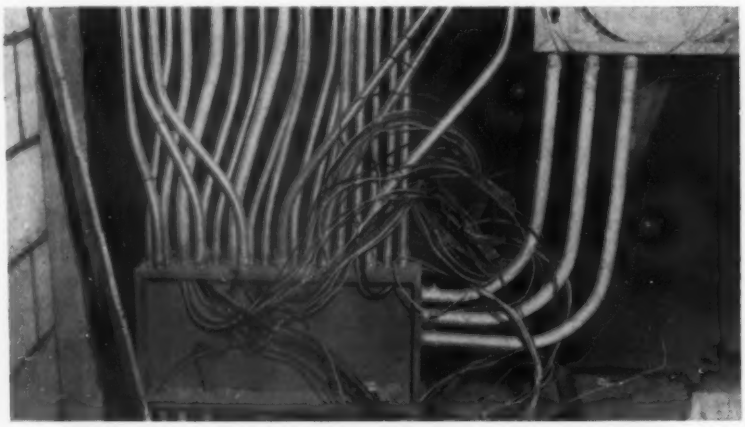
**MAZE OF CONDUITS** and pull boxes suspended from basement ceiling slab and beams indicates extent of circuiting for lighting, motors, heating and control purposes. Mounting methods varied widely.



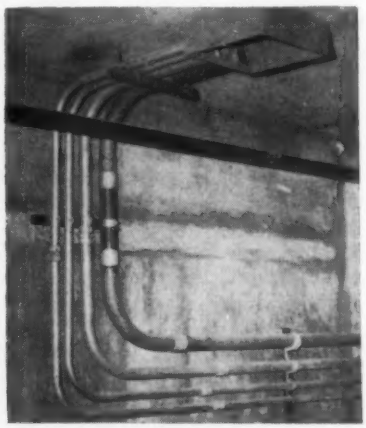

**PRIMARY SERVICE** to auditorium is underground, with a 750-kva transformer stepping 2300 volts to 3-phase 4-wire utilization level of 120/208-volts. Separate emergency power system is served by gas-operated generator and is activated by automatic transfer switch in the event of utility power interruption.



**CIRCUIT BREAKERS** in 4 wire 120-volt panels are thermal-magnetic. Panel gutters are liberally dimensioned to facilitate circuit connection. Secondary feeders are carried to panels via conduit beneath basement floor slab, then up through hollow-block partitions, bending outwards at panel elevation.



**CONCENTRATION OF EMT** at control centers permits switching of stage-lighting equipment from panels located in the most functional locations.



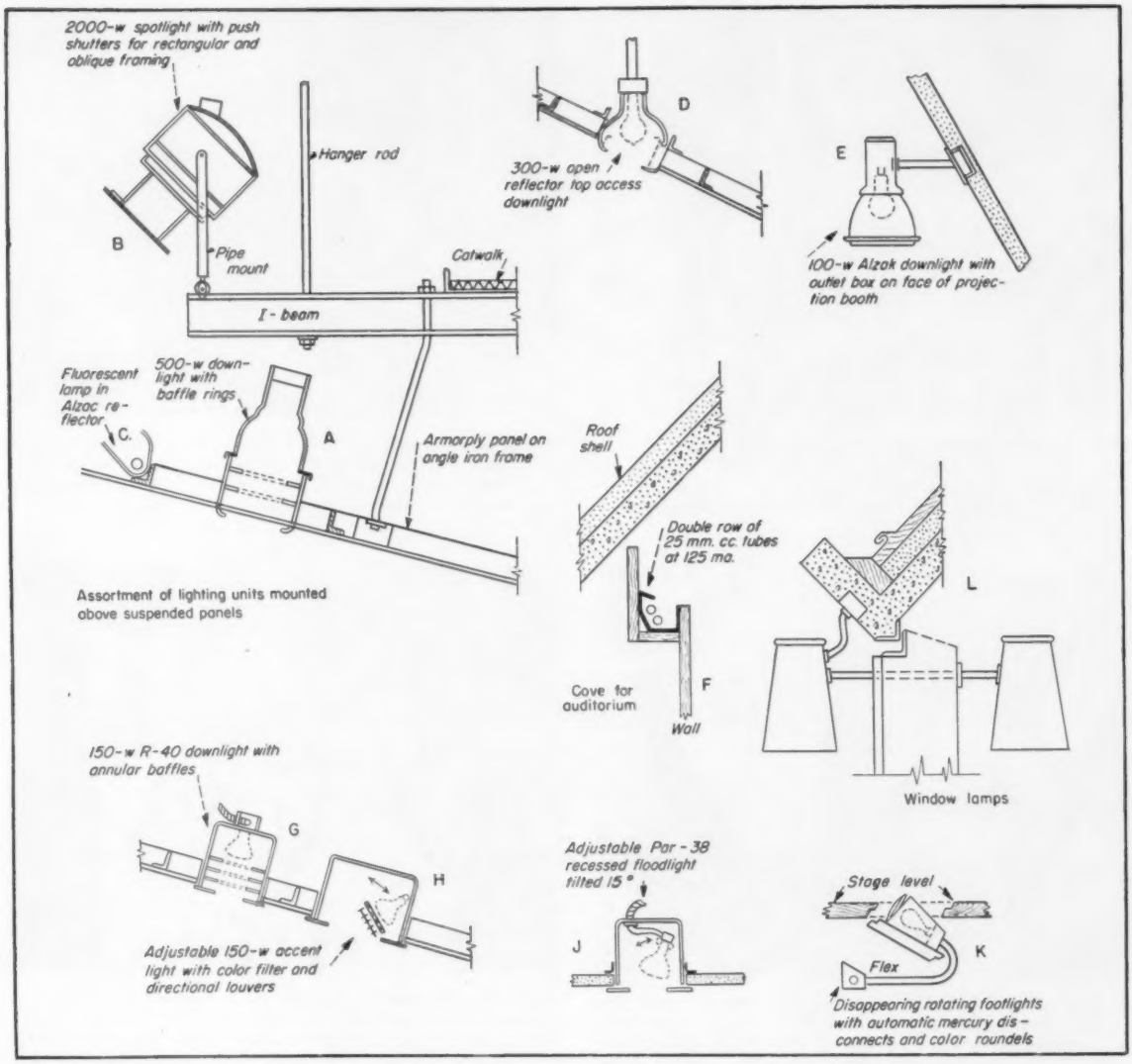
**MOUNTING METHODS** used to secure conduits and various types of enclosures to building structure included use of bar hangers, angle trapezes, Unistrut sections, welds and a wide assortment of clamps and concrete inserts, depending upon local structural conditions.

# Special Transformer and Generator

Initial primary power is brought into the structure underground through 4-in. concrete-sheathed fiber conduits via 250MCM cables. Power is 3-phase 3-wire service at 2300 volts. These underground cables are conducted to an electric service room, located on the lower level of the auditorium building adjacent to one of the three supporting abutments. Here service connects via 3/c potheads to a high-voltage fused oil disconnecting switch, thence to a 750-kva air-cooled transformer that steps current to the utilization level of 120/208-volts with wye neutral grounded. This Class B insulated transformer is specially constructed and mounted to maintain the hum level below a 72-decibel output, thereby insuring quiet operation and non-interference with programs being presented in the auditorium. This noise reduction is accomplished with an assembly that exceeds standards pertaining both to the amount of iron in the unit and to the extent and method of clamping the magnetic core. The entire installation is also cushioned to minimize transmission of vibration, and is securely bolted to channels embedded in the concrete floor.

To prevent the operation of the primary disconnect except when the main 3000-amp secondary breaker is in the opened position, these two breakers are key interlocked. This main secondary breaker is a draw-out 3-pole single-throw electrically-operated unit with a 3-coil trip and an IC of 75,000-amps. Secondary feeder breakers are likewise of the drawout type, designed for instantaneous tripping on short circuits, and equipped with overcurrent protection. They are rated for 1600-amps, are manually operated, have 50,000-ICs. Substation equipment is deadfront steel enclosed.

Adjacent to this transformer and switchgear room is an emergency generator installation, consisting of a 15-kw 120/208-volt generator plus a gas-operated L-head 1800-rpm engine. The generator is a 4-pole unit of the revolving field type, with exciter and alternator directly connected. A starting panel is provided with an automatic transfer switch that starts the gas




**ILLUMINATION** in the two auditoriums is provided by an assortment of downlights, louvered units, 2000-watt shuttered spots, disappearing footlights, cold-cathode cove arrangements, and both outside and inside ornamental fixtures for the huge glass exterior curtain walls.

generator when normal utility power fails, the actual transfer being delayed until the generator is up to speed and both frequency and voltage are stabilized at their rated levels. When utility service is returned, the generator automatically cuts out. This emergency unit supplies power for lighting exit signs, aisles, corridors and certain critical-area service sections; the circuits for these fixtures being carried in a conduit system completely separated from normal distribution.

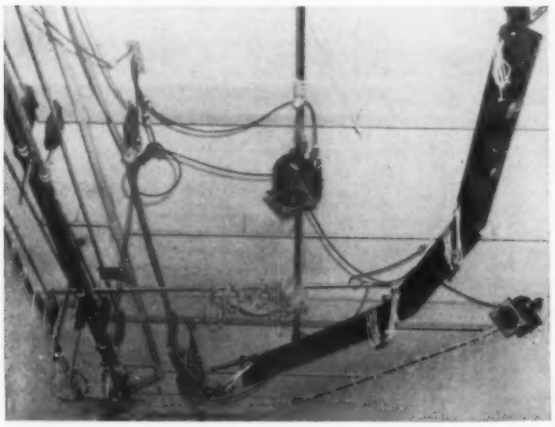
Beneath this service area is a grounding network consisting of seven 8-ft. rods arranged in a multiple-triangle pattern, rods driven 6-ft. on centers and connected with stranded bare 4/0 copper cables. To this network are connected the neutral of the 120/208-volt electrical system, the transformer frame, switchgear housings and all conduit systems. Also connected to these ground rods is a $1\frac{1}{2}$- by $\frac{1}{4}$-in. copper bus, mounted along all walls in the electric rooms to facilitate grounding of wall panels, boxes and similar related equipment.

From the load side of feeder breakers in this substation, secondary feeders radiate to six strategically-placed power distribution panels, 11 lighting panels, four auditorium switchboards and two stage managers' control desks. In general, all secondary power feeders are run below the floor of the lower level, these underground conduits being encased in 3-inch concrete envelopes, and all such conduit joints being completed with tightly-screwed and red-leaded couplings. Fiber ducts are used only outside the building. All ducts are pitched to insure proper drainage.

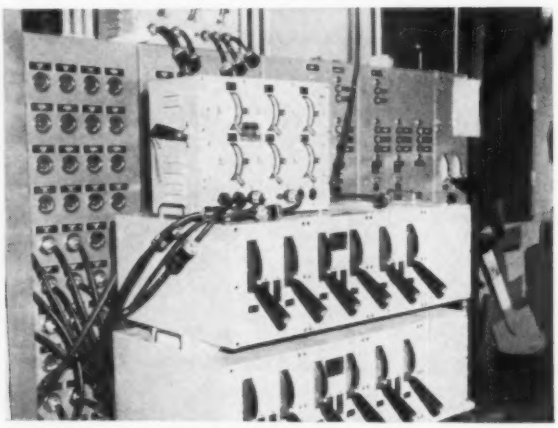
Distribution panels in all instances are dead-front units with lugs only for the connection of feeder cables, and with main breakers rated for either 800-, 400- or 200-amps, depending upon local loading conditions. Switches controlling branch circuits serving receptacles and motors are of the fused swing-out type, circuits being automatically taken out of service when switches are opened. Breakers in 120-volt 4-wire panels are of the thermal-magnetic type, with solid common neutrals serving all 2 wire circuits.

**PROJECTION BOOTH** suspended from shell above rear of main auditorium is equipped with complete facilities for projection of still or motion pictures. Equipment is also provided for transmission or reception of television programs, radio broadcasts or tape recordings.

**HOUSE AND STAGE LIGHTING** may be regulated from control desk overlooking auditorium through glass-fronted booth. Intercom system at right of desk also permits communications with stations located along overhead catwalks, orchestra pit, stage wings and auditorium entrance.



**OVERHEAD OF LITTLE THEATRE** contains remotely-controlled power receptacles, pipe battens for suspension of lighting equipment, sectional border-lights to illuminate movable cyclorama, and sheave blocks for supporting scenery drops. Floor of stage has recessed stage pockets, cyclorama pit and retractable footlights; all covered when not in use.



**PORTABLE DIMMING EQUIPMENT** is rubber-tired to permit soundless shifting of control points, and dimensioned to permit free passage through all doorways and elevator portals. Twist-lock patch-cord assemblies also permit pre-arrangement of desired lighting effects. This assembly is used for small, lower stage in M.I.T.'s pace-setting auditorium.

# Flexible Power Control

Within the two auditoriums proper, lighting, sound, and many motor-operated devices are controlled from a movable stage manager's desk, the main projection booth, or from one of the four switchboards — respectively located adjacent to the podium, in one of the main stage wings, at the rear of the lower-level hall, or in a room adjacent to the choir loft. These boards and control desks are collectively equipped with main feeder connections and switches to activate remote single-pole contactors that permit the selection of pre-arranged lighting effects. These boards also control dimmers (both manual and motor-operated), branch lighting panels, convenience receptacles for extension cords, Twist-lock plugs for patching purposes, transfer switches that permit the shifting of control points, motorized movie screens, curtains and organ blower. All portable equipments (including stage managers' desks, motor-operated dimmers, etc.) are mounted on rubber-tired castors and are dimensioned to permit free, silent movement through doors, on or off of the elevator, or from one position to another on the stages.

Stage managers' and projection booth desks have sloping tops and hinged-front cabinets to facilitate the making of field connections, while all connection and extension cords are 2/c neoprene-jacketed 600-volt cables, 12 gauge or larger. All receptacle outlets for special stage, podium, hall or auditorium lighting were rung out during the initial installation, then marked with stencilled designation tags or plates secured to boxes or to the receptacles themselves. Flexible cords are also marked, using adhesive labels for accurate identification.

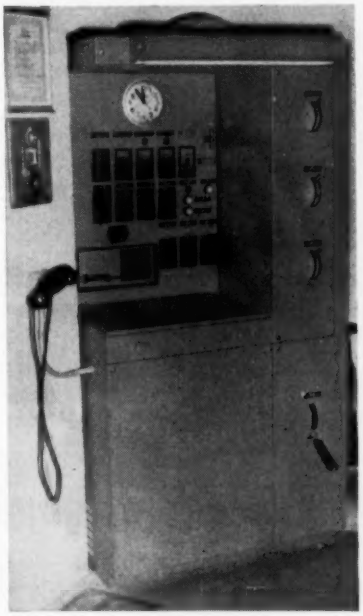
All motors in the building are totally enclosed, fan cooled, self-ven-

**SMALL AUDITORIUM,** located on lower level of dome-shaped structure, is generally illuminated by adjustable, recessed, inclined and shielded PAR ceiling fixtures. Cove across front of hall shields striplights and battery of flood- and spot-lighting equipment. Both theatres are air conditioned, summer and winter.

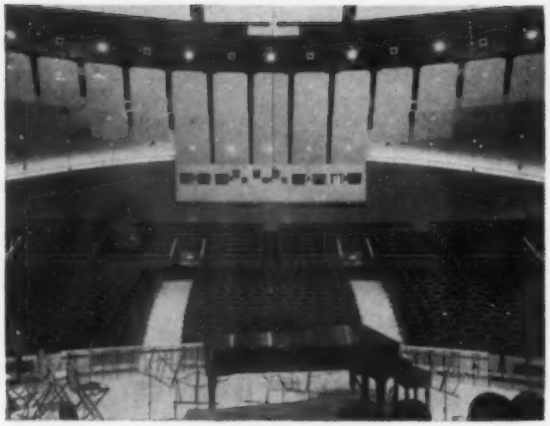
tilating ball-bearing units. Motors of ½-hp or larger are 208-volt 3-phase squirrel cage induction types, while smaller units are single phase 120-volt capacitor types. All motors using belt drives are fitted with sliding bases, rails and adjustment screws to secure proper tension on the drives. Starters for automatically controlled motors are combination non-fused magnetic across-the-line devices for motors of 15-hp capacity or less, while motors larger than 15-hp are operated through resistance type reduced voltage starters. All manually controlled motors are line voltage types, with on-off indicators and thermal overload protection. Pushbutton stations for automatically controlled units are either lever or 3-button assemblies, marked "Manual", "Automatic" and "Off". Where buttons are remotely located with respect to the motors they control, pilot lights are included for the operator's information and (even when combined with magnetic starters and 208-volt induction motors) all pushbutton and auxiliary circuits are 120-volts.

In addition to 120/208-volt services in the auditorium building, a 12-volt cue signal system of lights and pushbuttons permits visual communication between the stage managers' desks, projection booth, switchboards, sound control room and podium. With this system, cue signals originate at the managers' desks, and are acknowledged by pilot lights which are activated remotely by pushbuttons at the various stations. Another low-voltage service is a 10-station intercom system that links stage managers' desks with dressing rooms, catwalks, the box office, projection booth, both wings of the stages and a position in the center of the auditorium (for use during rehearsals). Each of these positions is a master station, permitting building-wide inter-calls or private conversation between points.

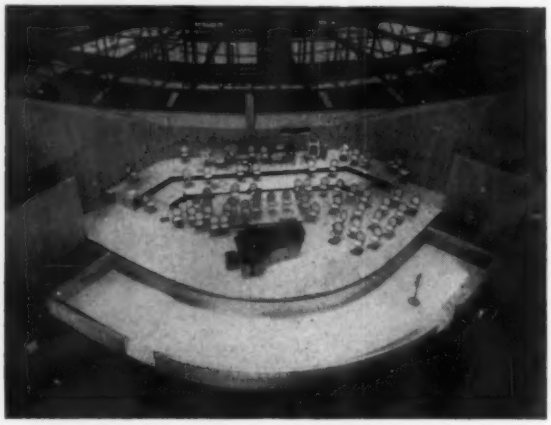
Another independent conduit system is provided for television use, with heavy-wall pipe running from projection booth to choir loft, thence to the outside rear of the building. This conduit system, provided in order to facilitate the televising of programs originating within the auditorium building, carries coaxial cables to weatherproof plug-in facilities for mobile monitoring vans. In this system, all connections between conduit lengths, terminal cabinets or junction boxes are made by screw-type couplings plus tack welds, thereby insuring positive bond and exclusion of static.



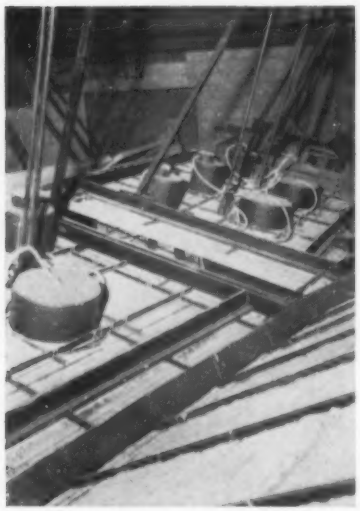
**STAGE MANAGER'S DESK** in wing of little theatre overlooks acting area, is equipped with intercom telephone station, local illumination, dimming equipment, indicating bullseye lights, signalling and switching devices for comprehensive supervision and activation of all activities related to a production.



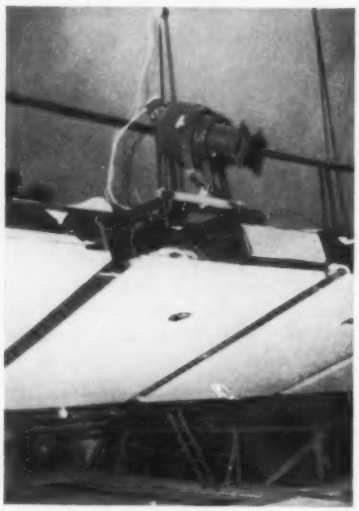
**LOOKING UP FROM THE STAGE** of the main auditorium shows positioning of suspended projection booth at rear of hall, dimmer-controlled cold-cathode coves along upper edges of walls, and suspended acoustical "clouds" that shield down- and spot-lights, air-conditioning ducts and louvers, catwalks, electrical distribution and intercom features.



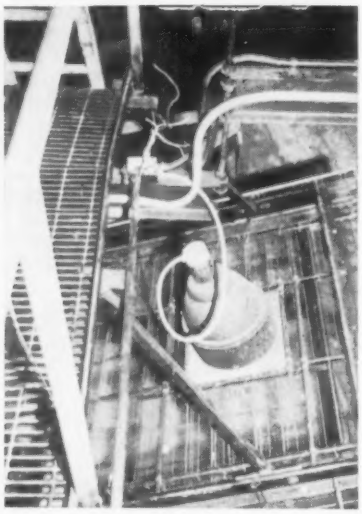
**LOOKING DOWN FROM REAR "CLOUDS"** gives birdseye view of auditorium stage, wings, orchestra pit, front tier of acoustical baffles, some of the lighting equipment and sections of overhead catwalks. Easy access to all lighting units, plus convenience of intercom stations, greatly facilitates adjustment, location and maintenance of equipment.



**DOWNLIGHTS,** incorporated in forward, inclined panels of the acoustical clouds, are equipped with variety of annular baffles, directional louvers and color filters. Edges of panels also shield fluorescent lamps in strip reflectors.



**2000-WATT SPOTLIGHTS,** also mounted above clouds, are equipped with shutters for rectangular or oblique framing of light-beams directed towards stage. Access to these units is via catwalks located immediately behind them.



**CATWALKS** provide access to these 500-watt downlights, thereby facilitating aiming, relamping and maintenance. Phone and public-address jacks along walk-ways are provided for communication purposes and special sound effects.

# Progressive Illumination

Throughout the building are many special luminaires fashioned by Century, also numerous cold-cathode cove treatments utilizing 3500-degree Kelvin 25-millimeter tubing operated through 120-milliamp transformers. Aside from these cove installations, fluorescent lamps are generally deluxe cool white, although those on dimmer-controlled circuits are new-white, designed for that purpose.

Design for this revolutionary structure was conceived by architect Eero Saarinen of Bloomfield Hills, Mich., assisted on the jobsite by Boston architects Anderson and Beckwith. Electrical and mechanical engineering was by Hyde and Bobbio of Detroit; structural engineering by Ammann and Whitney of New York City. Constructor for the project was the George A. Fuller Company of Boston, represented on the site by superintendent Douglas Bates, assisted by Robert Scofield. Key men on the job for Hixon Electric were supervisor Charles E. Davis, and electrical foreman Leonard White.

Since this 3-cornered dome-like structure is reminiscent of a Colonial head-dress, and since methods are unique, the job—literally—is a Wiring Revolution in a Cocked Hat.

**MODERN LUMINAIRES** light typical school classroom without glare or shadows to intensity of 30 or more footcandles throughout.

# Economics of Classroom Lighting

**A lighting cost analysis of nine different lighting systems for a typical school classroom which provides a sound basis for selection of an economical lighting system for any school under specific conditions.**

**By Robert L. Zahour, Lamp Division**
*Westinghouse Electric Corporation, Bloomfield, New Jersey*

**As our school-age population increases year after year, so does the demand and need for more classroom capacity. An estimated $3 billion will be spent during 1955 for new schools, and President Eisenhower has proposed a stepped-up program of new school construction over the next three years.**

**School authorities, architects, and parents are all generally aware of the importance of good classroom lighting. Quite often, however, they are less well informed on what constitutes good lighting. In addition, they quite frequently are faced with the problem of providing good lighting within a limited budget.**

**The accompanying article provides a sound basis for analyzing the cost of any proposed lighting system; hence, for comparing one system with another. It contains the full analysis of nine lighting systems which are currently in general use. It also focuses attention to the three major problems usually involved in classroom lighting—total initial cost, annual fixed cost, and annual operating cost. Consulting engineers, electrical contractors and others will find it of considerable value in discussing the qualities and economics of various types of lighting systems and lighting equipments with architects, school boards, parent-teacher groups and others interested in adequate classroom lighting on a budget.**

***Editor***

THE basic function of a classroom lighting system is to provide an adequate level of good quality illumination that will permit students to do their 3-R's with eye comfort. To promote this objective, the American Standards Association has adopted recommended minimum lighting levels for various school building areas. These have been published in its *American Standard Practice for School Lighting*. A minimum level of 30 footcandles is recommended for desk tops in classrooms (Table I). Furthermore, to provide lighting surroundings that will insure eye comfort, the ASA recommends limiting the ratio of brightness of the paper work and the desk top to the brightness of the general field of vision, so that this ratio is within a specific acceptable value. These brightness ratios have been interpreted and transposed to re-

## TABLE I—AMERICAN STANDARD PRACTICE FOR SCHOOL LIGHTING

LIGHTING LEVELS AT THE WORK
(Maintained in Service)

CURRENT RECOMMENDED PRACTICE

| Locations | Minimum Footcandles |
|---|---|
| Classrooms—on desks and chalkboards* | 30 |
| Study halls, lecture rooms, art rooms, offices, libraries, shops and laboratories | 30 |
| Classrooms for partially seeing pupils and those requiring lip-reading—on desks and chalkboards* | 50 |
| Drafting rooms, typing rooms and sewing rooms | 50 |

*Where schools use chalkboards extensively for demonstration purposes, higher levels than those indicated are desirable.

flection factors of surface finishes for the convenience of architects and others involved in the selection of colors and finishes of the classroom interiors. When pastel colors with reflectances which fall within the ranges shown are used, a pleasing atmosphere results that will be conductive to eye comfort. In addition, light-colored finishes reflect a greater percentage of illumination to the work areas than do darker finishes. This practice makes more efficient use of the lighting system, and requires a minimum number of lighting units to provide the recommended footcandle levels.

Lighting unit performance has been studied from the standpoint of proper shielding of light sources, efficient light distribution, and freedom from glare. Typical designs for lighting units suitable for lighting classrooms, two of which are considered in this lighting cost analysis, are shown in the illustrations.

### *Comparison of Lighting Layouts*

A series of eight lighting layout plans are considered in this analysis, with all plans based on the recommendations of the ASA *American Standard Practice for School Lighting*. For a basis of comparison, a standard classroom 24 ft by 30 ft, with a 12-ft high ceiling and with conventional windows in one side wall, has been used. It is assumed that the reflectances of walls, ceiling, desks and floor are within the recommended ranges as illustrated, and that all fluorescent luminaires are equipped with 3500-degree white fluorescent lamps.

### *Continuous Row Layouts*

PLAN 1, designed to provide 45 to 50 footcandles, consists of two continuous rows of suspension-type fluorescent luminaires with louver bottoms. Each row may consist of either six 4-lamp, 40-watt fluorescent luminaires, or three 4-lamp, 75-watt slimline fluorescent luminaires. The total electrical load, including ballast losses, is 2400 watts, or 1200 watts per row.

This is an economical lighting layout for sewing rooms, typing rooms, and other areas where severe seeing-tasks require lighting levels substantially higher than minimum classroom values. Substitution of semi-indirect luminous bottom luminaires will provide approximately 38 footcandles, which is suitable for recitation rooms.

PLAN 2 is a "minimum" layout whose 26 to 30 footcandles barely equal the ASA recommendations. It is designed for optimum conditions of maintenance and painting which are consistent with the higher values in the ASA's recommended reflectance ranges for room surfaces. This layout consists of two continuous rows, each with seven suspension-type direct-indirect luminaires containing two 40-watt fluorescent lamps per luminaire. The total electrical load is 1400 watts, or 700 watts per row. This low wattage requirement usually permits the use of existing wiring when old classrooms are being relighted.

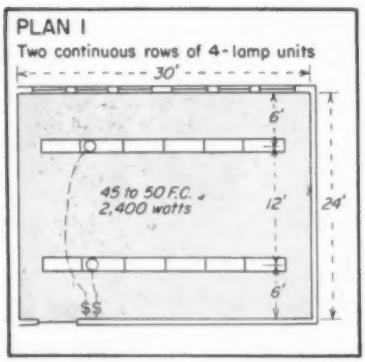
PLAN 3 provides 39 to 45 footcandles from three continuous rows of seven suspension luminaires with louver bottoms. Each luminaire contains two 40-watt fluorescent lamps. If luminous-bottom semi-indirect luminaires are used, the footcandle level will be approximately 32 footcandles. For either type of luminaire, the total electrical load is 2100 watts, or 700 watts per row.

### *Individual Unit Layouts*

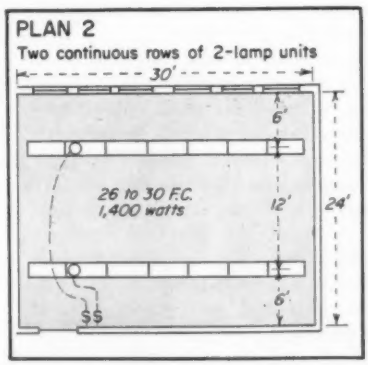
PLAN 4 consists of two non-continuous rows of four suspension-type direct-indirect luminaires mounted at existing outlets formerly used for incandescent luminaires. While this plan provides 30 to 35 footcandles, the distribution of illumination is not as uniform as that from continuous rows. However, a minimum number of luminaires is required, which might be an important factor from the standpoint of luminaire cost. The total load is 1600 watts, or 200 watts per outlet.

In new construction, the saving on luminaire cost would be nullified by the additional cost of installing eight individual outlets rather than the two outlets only required for the continuous rows shown in Plans 1 and 2.

PLAN 5 is similar to Plan 4, except that two 4-lamp, 40-watt fluoresecnt, direct-indirect, suspension-type, louver-bottom luminaires are installed at each of four existing outlets. This layout provides 30 to 35 footcandles, but the light distribution is not entirely uniform. For this reason the plan is used where the budget for relighting is very limited. The total electrical load is 1600 watts, or 400 watts per outlet.




**LIGHTING LAYOUT** for standard classroom, using 12 4-lamp 40-watt standard fluorescent lamps, or 6 4-lamp 75-watt slimline lamps, is practical where electrical outlets already exist.



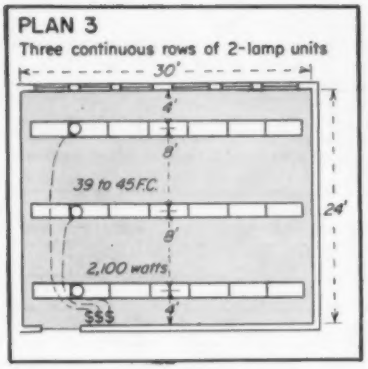

**MINIMUM LIGHTING** layout using 14 2-lamp 40-watt fluorescent luminaires can often be used on existing wiring to meet lighting requirements when maintenance and painting are good.

## TABLE II—COST OF LIGHTING ANALYSIS FOR TYPICAL SCHOOL CLASSROOM

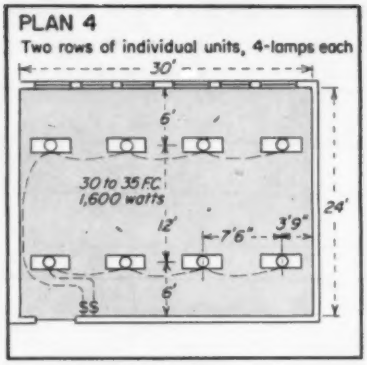
### (Dimensions: 24 ft. x 30 ft. x 12 ft.)

| | LIGHTING SYSTEM DESIGNATION | | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DESCRIPTION OF LIGHTING SYSTEMS | 1. Type of lamp (Fil., Merc., Fluor., Etc.) | | Preheat | Rapid Start | | Instant Start | | Slimline | | Incandescent | |
| | 2. Lamp description | | 40-W 48T12 | 40-W 48T12 | 40-W 48T12 | 40-W 48T12 | 38-W/48 T12/425 | 74-W/96 T12/425 | 40-W/96 T12/200 | 500-W S8 | 1000-W S8 |
| | 3. Type of luminaire | | (Direct-Indirect with 30° Louver Bottom) | | | | | | | Suspended Concentric Ring | |
| | 4. Number of lamps per luminaire | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| BASIC DATA | 5. Rated initial lamp lumens per luminaire | | 5200 | 5200 | 5200 | 5120 | 4840 | 10380 | 5820 | 9250 | 21000 |
| | 6. Lamp life (6 hours per start) | | 9300 | 9300 | 9300 | 9300 | 9300 | 9300 | 9300 | 1000 | 1000 |
| | 7. Watts per luminaire (including auxiliary) | | 95.5 | Lead Lag 103 | Series 97 | 104 | 100 | 183 | 110 | 500 | 1000 |
| | 8. Coefficient of utilization—F (80% Clg., 50% Wall) | | .44 | .44 | .44 | .44 | .44 | .44 | .44 | .27 | .27 |
| | 9. Mantenance factor (good) | | .7 | .7 | .7 | .7 | .7 | .7 | .7 | .7 | .7 |
| | 10. Number of luminaires | | 14 | 14 | 14 | 14 | 14 | 9 | 12 | 9 | 6 |
| | 11. Average footcandles maintained | | 31 | 31 | 31 | 31 | 29 | 40 | 30 | 22 | 33 |
| | 12. Energy rate ($ per kwhr)* | | .02 | .02 | .02 | .02 | .02 | .02 | .02 | .02 | .02 |
| | 13. Estimated burning hours per year | | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 |
| INITIAL COST | 14. Net luminaire cost (each) | $ | 20 | 23 | 21 | 25 | 26 | 40 | 40 | 10 | 15 |
| | 15. Net additional accessory cost per luminaire | $ | 2 | 2 | 2 | 2 | 2 | 2 | 2 | — | — |
| | 16. Estimated wiring & installation cost per luminaire | $ | 10 | 10 | 10 | 10 | 10 | 18 | 17 | 15 | 20 |
| | 17. Net initial lamp cost each (list less 30%+tax) | $ | 0.88 | 0.92 | 0.92 | 1.00 | 1.40 | 2.80 | 2.80 | 1.40 | 4.00 |
| | 18. Net initial lamp cost per luminaire (4×17) | $ | 1.76 | 1.84 | 1.84 | 2.00 | 2.80 | 5.60 | 5.60 | 1.40 | 4.00 |
| | 19. Total initial cost per luminaire (14+15+16+18) | $ | 34.70 | 36.84 | 34.84 | 39.00 | 40.80 | 65.60 | 64.60 | 26.40 | 39.00 |
| | **20. TOTAL INITIAL COST (10×19)** | $ | 486 | 516 | 488 | 546 | 570 | 590 | 775 | 240 | 230 |
| ANNUAL FIXED CHGS. | 21. Initial cost per luminaire less lamps (14+15+16) | $ | 32 | 35 | 33 | 37 | 38 | 60 | 59 | 25 | 35 |
| | 22. Total initial cost less lamps (10×21) | $ | 448 | 490 | 462 | 518 | 532 | 540 | 708 | 225 | 210 |
| | **23. ANNUAL FIXED CHARGES (—%* of 22)** | $ | 67 | 74 | 69 | 78 | 80 | 81 | 106 | 34 | 32 |
| ANNUAL OPERATING COSTS | 24. Annual no. lamp replacements (4×10×13÷6) | | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.4 | 1.8 | 6.3 | 4.2 |
| | 25. Annual cost of replacement lamps (17×24) | $ | 2.00 | 2.00 | 2.00 | 2.00 | 3.00 | 4.00 | 5.00 | 9.00 | 17.00 |
| | 26. Annual cost of replacement parts (starters, etc.) | $ | 0.25 | — | — | — | — | — | — | — | — |
| | 27. Total annual maintenance material cost (25+26) | $ | 2.25 | 2.00 | 2.00 | 2.00 | 3.00 | 4.00 | 5.00 | 9.00 | 17.00 |
| | 28. Estimated labor cost to replace one lamp | $ | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| | 29. Total labor cost to replace lamps (24×28) | $ | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.75 | 1.00 | 4.50 | 8.50 |
| | 30. Estimated cleaning cost per luminaire | $ | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.75 | 1.75 | 1.00 | 1.00 |
| | 31. Number of cleanings per year | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| | 32. Annual cleaning cost (10×30×31) | $ | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 9.00 | 12.00 | — | — |
| | 33. Total annual maintenance labor cost (29+32) | $ | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 9.75 | 13.00 | 4.50 | 8.50 |
| | 34. Total annual maintenance cost (27+33) | $ | 17.25 | 17.00 | 17.00 | 17.00 | 18.00 | 13.75 | 18.00 | 13.50 | 25.50 |
| | 35. Annual energy cost (7×10×12×13÷1000) | $ | 19.00 | 20.00 | 19.00 | 20.00 | 20.00 | 23.00 | 18.00 | 63.00 | 84.00 |
| | **36. TOTAL ANNUAL OPERATING COST (34+35)** | $ | 36.25 | 37.00 | 36.00 | 37.00 | 38.00 | 36.75 | 36.00 | 76.50 | 109.50 |
| TOTAL AND RELATIVE COSTS | **37. TOTAL ANNUAL COST (23+36)** | $ | 103.25 | 111.00 | 105.00 | 115.00 | 118.00 | 117.75 | 142.00 | 110.50 | 141.50 |
| | 38. Relative annual cost* | | 100 | 107.5 | 102 | 111 | 114.5 | 114 | 137.5 | 107 | 137 |
| | 39. Annual cost per footcandle (37÷11) | $ | 3.32 | 3.57 | 3.38 | 3.76 | 4.07 | 2.96 | 4.75 | 5.07 | 4.28 |
| | 40. Relative annual cost per footcandle* | | 112 | 120.5 | 114 | 127 | 137 | 100 | 160.5 | 171 | 144.5 |

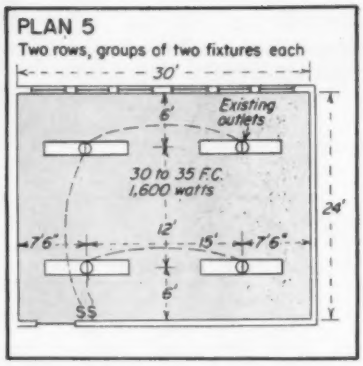
*12. National average as reported by Edison Electric Institute.
*14. Contractor's price.
*23. Usually 15%, assuming 10 year amortization with 5% allowance for taxes, insurance and interest.
*38. Based on lowest annual cost as 100%.
*40. Based on lowest annual cost per footcandle as 100%.



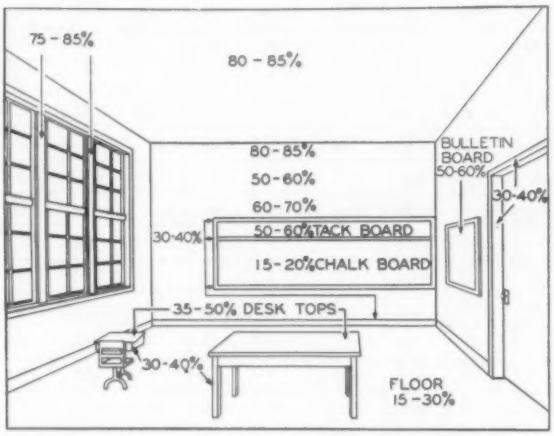

**THREE CONTINUOUS ROW** layout using 21 2-lamp 40-watt fluorescent luminaires provides maximum uniformity of light distribution, is ideal for rooms wider than 24 feet with 12-ft. ceiling.



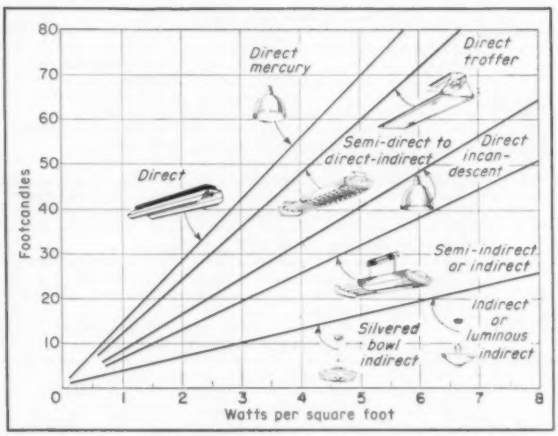

**MINIMUM LUMINAIRES** required for ASA recommended minimum of 30 footcandles is 8 4-lamp 40-watt units with louver bottoms. Layout requires one outlet for each unit.




**LIGHTING LAYOUT** for classrooms having four outlets each with capacity of 400 watts already installed uses 8 4-lamp 40-watt fluorescent luminaires in 4 groups of two units each.




**BRIGHTNESS CONTRASTS** are kept visually comfortable when surface reflection factors range between the values shown above for ceilings, walls, furniture and floors.




**LIGHTING LEVELS** increase with electric power consumption for different types of luminaires according to light distribution characteristics and type of light source.

PLAN 6 is an offset layout for combining daylight with electric lighting. In combination with daylight, this system will provide in excess of 30 footcandles. Each of the existing outlets is provided with a louver-bottom suspension-type fluorescent luminaire containing four 40-watt fluorescent lamps. The total load is 1200 watts, or 200 watts per outlet.

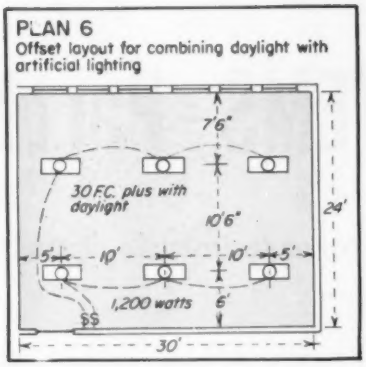
PLAN 7 is an incandescent lamp layout. When each of the six outlets is provided with 750-watt semi-indirect luminaires, the total electrical load is 4500 watts, and the lighting level produced is 25 to 27 footcandles. Semi-indirect luminaires using 500-watt lamps will provide 15 to 17 footcandles at a total electrical load of 3000 watts. In a system of this type, the ceiling brightness is spotty, the wiring cost is higher than in fluorescent lighting layouts, and the operating cost is higher. The quality of illumination is fair but below ASA recommended standard.

PLAN 8 shows nine incandescent luminaires. With nine semi-indirect type luminaires and 750-watt inside-frosted lamps, from 30 to 33 footcandles are provided and the total electrical load is 6750 watts. Using concentric ring luminaires with 500-silvered-bowl lamps, a lighting level ranging from 22 to 26 footcandles is obtained at a total electrical load of 4500 watts.

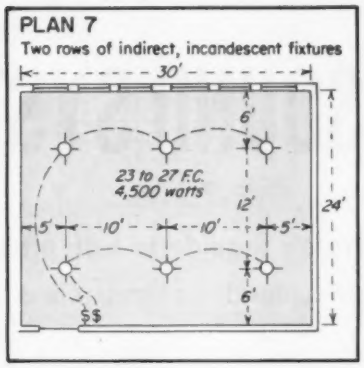
While this lighting layout creates a more uniform ceiling brightness than Plan 7, the wiring and operating costs are higher than for comparable fluorescent lighting systems.

### *Analysis of Costs*

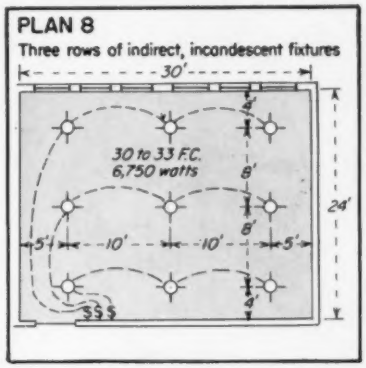
In analyzing the eight lighting plans it becomes obvious that there are many economic factors involved in the design of school classroom lighting systems. Because of their higher efficiency and longer life, fluorescent lamps can provide recommended ASA illumination levels more economically than can incandescent lamps. Furthermore, for a specified footcandle level, incandescent lamps require much higher electrical loads than fluorescent lamps, and consequently demand



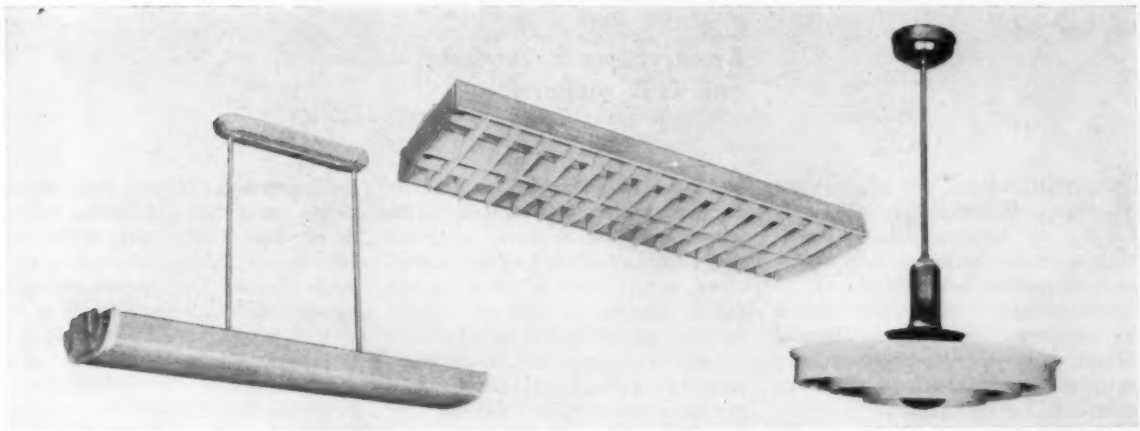

**DAYLIGHT** and lighting layout of 6 4-lamp 40-watt fluorescent luminaires with window row offset to provide a closer spacing of units may be combined for rooms used only for daytime classes.




**SIX SEMI-INDIRECT** incandescent luminaires each with one 750-watt lamp, provide less than recommended 30 footcandle levels. With 500-watt lamps, intensity drops to 15 to 17 footcandles.




**NINE INCANDESCENT** luminaires provide above 30 footcandles, with improved uniformity in ceiling brightness, but uses total of 6750 watts. Three rows improve control flexibility.



**TYPICAL LUMINAIRES** for school classroom lighting include: (left) semi-indirect with plastic bottom and sides; (center) direct-indirect with louver bottom; and (right) concentric ring unit with silvered-bowl incandescent lamp. In general, the "first cost" of lighting units only is highest for semi-indirect fluorescent, lowest for the incandescent unit at right.

heavier electrical wiring. This feature alone favors fluorescent intallations when little or no rewiring cost is allowed for relighting. Electrical load requirements for various types of luminaires for different lighting intensites (footcandles) are shown in chart separately.

Another factor of importance, but on which it is difficult to place a cost value, is the problem of heat generated by a lighting system. Considerable heat is created by the incandescent lighting of Plans 7 and 8, and might be undesirable for classrooms in Southern States during the early fall and late spring months. On the other hand, this heat could be utilized to aid in heating the same classrooms on colder days, or the classrooms of schools located in colder climates. Fluorescent lighting systems use less energy, hence produce less heat. The fluorescent lighting systems of Plans 1 through 6 would be preferred where it is desirable to minimize heat.

In order to properly evaluate the many economic factors involved, it is helpful to prepare a lighting system cost analysis which shows a comparison of the various lighting systems that will provide recommended footcandle levels of good quality illumination. Such a lighting system cost analysis has been made for nine different lighting system layouts, each layout being based on a different type of light source. This cost analysis is given in Table II. *It is not related to the eight lighting plans already discussed.* Since the end result of any lighting system is the maintained level of illumination at the work area, and at the level of the desk tops, the cost analysis permits appraisal on a cost in "dollars per footcandle". These costs can then serve as the basis for the selection of the systems that will prove most economical. Then, too, a breakdown of the various items listed may serve as a guide in budget discussions. Since this cost analysis is focused on the three major lighting costs—total initial cost, annual fixed cost, and total annual operating cost—it permits each plan to be considered individually from each of these three standpoints.

***What the electrical man should know about . . . .***

# SOUND SYSTEMS—Part I

**Here's a guide to full, practical understanding of modern sound systems, covering—**

- ***Fundamentals of operation,***
- ***Application and system design, and***
- ***Installation data.***

**By Mortimer S. Sumberg,** *David Bogen Co., Inc., New York, N. Y.*
**and J. F. McPartland**

A BASIC system for paging and music distribution is shown in Fig. 1. As shown, the system is built around a packaged assembly of equipment from which music or information is distributed to the system loudspeakers. The program material delivered to the loudspeakers may originate from one or more sources, as follows:

*Microphone* — which transforms sound waves into electrical signals and feeds them to the amplifier.

*Radio tuner*—which picks up AM (amplitude modulated) or FM (frequency modulated) broadcast radio programs and feeds them to the amplifier.

*Record or tape player*—which picks up the electrical equivalent of sound from record discs or magnetic recording tapes and feeds the signal to the amplifier.

*Tone generator*—which produces the electrical signal equivalent of a tone used for fire and other alarm signals or of the sound of church bells or chimes.

The output signal from each of these sources requires considerable strengthening and modification of its characteristics before it can be distributed to a number of loudspeakers. Two pieces of closely-related equipment accomplish the necessary boosting of the signal: the preamplifier and the power or booster amplifier. The preamplifier compensates for the low level of the initial signal due to characteristics of the particular device (microphone, tuner, etc.) which is supplying the signal. It also provides for suitable intermixing, where desired, of several signals (i.e. several microphones located on a stage) and is that part of the equipment at which the operator may make adjustments in volume and tone of the loudspeaker output.

A signal which has been properly amplified and prepared by the preamplifier is fed into the power or booster amplifier, where it picks up the necessary power to make long runs in cables to loudspeakers and to drive the loudspeakers so the sound output of each is loud enough for the area to be covered. The booster amplifier is available in various sizes, depending upon the amount of power required to drive the loudspeakers in the system. A number of booster amplifiers of identical characteristics are frequently paralleled where higher power is required. In custom-assembled consoles or cabinet racks, the preamplifier and booster amplifier(s) are usually mounted close to each other. However, preamplifiers are sometimes installed in a main operating center and booster amplifiers in several outlying buildings.

It is important to understand at this point, however, that by far the largest number of sound installations employ an amplifier which combines both the preamplifier and booster amplifier on a single chassis. The separate preamplifier is usually confined to large installations, of the console or cabinet rack type. When a sound man refers to an amplifier, he almost always means the single chassis unit combining preamplifier and booster amplifier. Fig. 2 shows the three most common arrangements of amplifier and preamplifier.

Loudspeakers used in paging and music systems vary widely in size and type; all, however, perform the same function. The signal from the system power amplifier is supplied to the loudspeaker over two conductors and applied to the voice coil of the speaker, usually through a line transformer. Interaction of the signal current in the voice coil and the magnetic field in the speaker produces motion of the speaker's cone or diaphragm. This motion, in turn, produces variations in air pressure which are sound waves and correspond to the sound represented by the original signal input to the system.

In the layout and design of any paging and music system, each of the elements involved in the above described sequence of operation requires careful selection. Each part of the

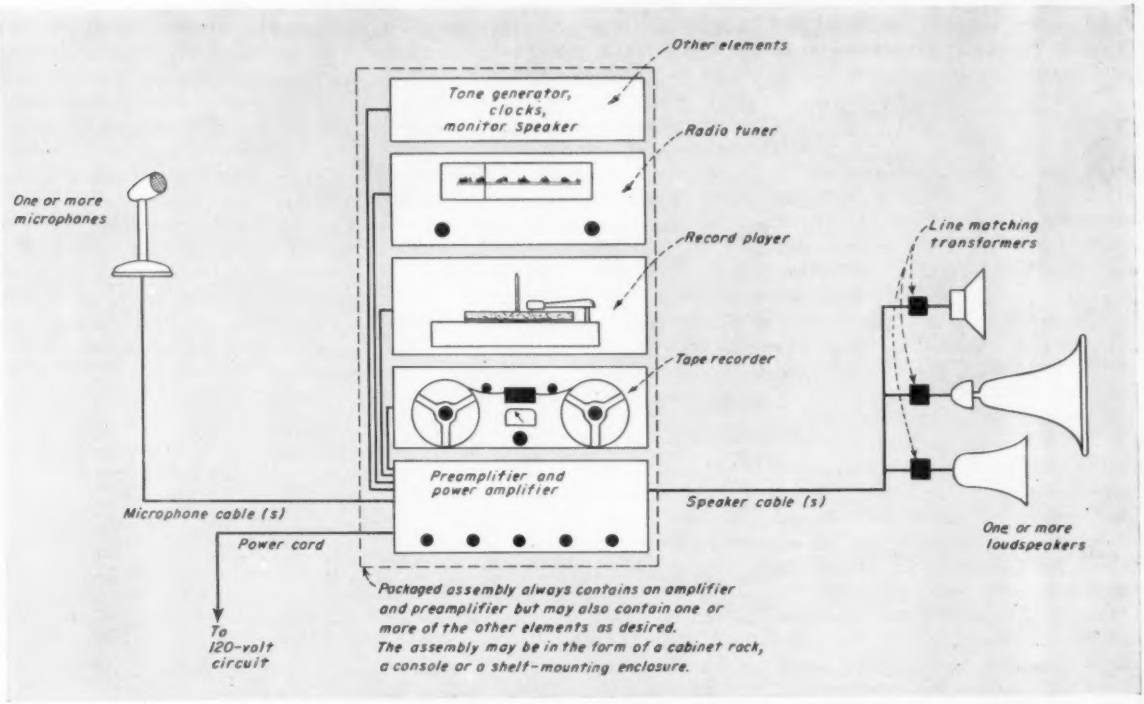

Other elements
Tone generator, clocks, monitor speaker
Radio tuner
Record player
Tape recorder
Preamplifier and power amplifier
One or more microphones
Line matching transformers
Microphone cable (s)
Power cord
Speaker cable (s)
One or more loudspeakers
To 120-volt circuit
Packaged assembly always contains an amplifier and preamplifier but may also contain one or more of the other elements as desired. The assembly may be in the form of a cabinet rack, a console or a shelf-mounting enclosure.

**FIG. 1 — Elements of A Paging and Music System**

system must be analyzed on the basis of particular requirements and existing conditions in the areas to be served by the system. Typical design and selection considerations for the various system components are given in the following paragraphs.

### Loudspeakers

Basically, there are two types of loudspeakers used in paging and music systems (Fig. 3):

1. *Horn speakers*—which are made of metal in the form of a flared horn or trumpet. In this type of speaker, sound waves are set up by a small moving diaphragm in a magnet assembly called a "driver". This compact driver is coupled to the small end of the horn and directs the sound into the horn. In passing through the horn, the sound waves are greatly strengthened in the same way that a megaphone strengthens the voice of a person shouting through it. In this category will be found so-called reflex trumpets (for directional sound projection), radial reflex projectors (for uniform dispersion in all directions), explosion-proof speakers (designed for hazardous duty), submersion-proof speakers (which are immune to salt spray, gases, live steam, etc.), two-way and wide-angle dispersion speakers (for covering corridors and large areas respectively).

2. *Cone speakers*—in which the moving, sound-producing diaphragm is a rigid, pressed-paper shallow cone. The cone is held in a basket or frame and is driven by a voice coil and magnet assembly at the apex of the frame. These include the small speaker found in your kitchen radio and the 15-in. diameter high-fidelity speaker which affords so much pleasure in high-fidelity home reproducing systems.

Horn or trumpet type loudspeakers are capable of very high-power sound output. They have a very high efficiency of electric-power-to-sound conversion (over 15%) and are particularly suited to outdoor application—playgrounds, athletic fields, stadiums, etc.—and indoor applications where high sound power is required to cover large areas—auditoriums, factories, warehouses, etc. Horn type speakers require no auxiliary enclosures or baffles and their rugged construction adds to their heavy duty, reliable, weather-resistant nature. One leading manufacturer has designed a super-power projector incorporating a large number of driver units which will handle up to 500 watts of power, making it an excellent speaker for sound-casting from aircraft. At the other extreme will be found small

**In preparing this article on the operation, selection and installation of sound systems, every effort has been made to present basic facts as clearly as possible for those who have had little previous practical experience in this highly specialized branch of the electronics field. The use of sound systems in virtually every type of construction has shown a tremendous increase in the past decade, requiring of the electrical engineer and electrical contractor a basic understanding of the elements of the subject so that consideration can be given at the time of construction to conduit layout and speaker placement. New construction requires farsighted planning if an adequate sound system is to be accommodated; existing construction presents innumerable problems to the installation of a sound system. A basic knowledge of fundamentals, therefore, can save considerable time and money. To this end, this article has been prepared—as an aid and guide in the installation of sound systems in present day construction. It is intended essentially as a primer for those who will be responsible for system planning and installation of cable, loudspeakers, microphones and amplifiers.**

metal paging speakers frequently tied in with intercom systems to cover small outdoor areas.

### Types of Horn Speakers

A wide variety of particular models and sizes of horn type speakers is available, each making a different compromise between: dispersion of sound, fidelity of sound reproduction and distance of sound penetration. There are, however, certain characteristics common to all horn speakers:

*Directivity*—Depending upon the particular shape of the horn or multiple horns to which the driver is coupled, the sound output is more or less beamed from the horn. For this reason, the trumpet speaker is singularly effective in projecting sound over several hundred feet. Broad coverage from horn speakers is obtained with wide-angle dispersion horns and radial reflex projectors.

*Limited frequency response*—Horn speakers are not capable of the wide-range frequency response of the better cone loudspeakers. For this reason, and other advantages of the cone speaker, horn speakers are generally not used where reproduction of music is an important function of the speaker but are confined largely to paging and voice reproduction. In fact, their limited frequency response, directivity and high efficiency all combine to make the horn speaker ideal for industrial locations where a generally high level of noise requires a sharp, piercing reproduction of voice to over-ride the noise and for interiors where reverberation (sound bouncing around the place) is a problem. The limited frequency response of a horn speaker and its dispersion angle may be intelligently utilized to reduce reverberation or echo effects.

### Cone Speakers

Cone type loudspeakers have a relatively wide-range frequency response, but their efficiency is much lower than that of the horn type speaker. Cone speakers are capable of clean, faithful reproduction of the complete range of sounds produced by musical instruments. For this reason, they are preferred for use in music distribution systems wherever possible. And although they lack the long distance penetration of trumpets and large area coverage from a single unit, their characteristics are ideal for paging and voice reproduction in applications where the general noise level is not high. Cone type speakers are generally used in indoor applications of paging and music systems where no severe acoustic problems exist. And even for outdoor applications where high fidelity reproduction is required, cone speakers are often used in special weatherproof enclosures.

In recent years we have seen the design of a unique speaker which combines in a compact, heavy gauge, all-metal dual-horn assembly, a low frequency cone speaker and a driver type high frequency reproducer. This corrosion-resistant assembly, employing the advantages of both horn and cone speaker, provides maximum protection against weather and affords extremely smooth overall response which dictates its use for concert halls, band shells, outdoor movie theatres.

For optimum results, cone type speakers should be used with a baffle or enclosure. Usually a wooden box or metal enclosure of some type, with the speaker mounted in it and a hole of proper size in front of the speaker cone, is used as the baffle. This mounting method assures maximum efficiency of speaker operation, minimizes distortion, smooths the frequency response of the speaker and discourages cancellation of the low frequencies. In high fidelity music systems, the baffle (frequently a large cabinet) is essential to the attainment of an undistorted adequate level of reproduction of low frequency sounds like the bass notes of drums, bull-fiddles and tubas. For general paging and music systems, a wide variety of plain and decorative baffle enclosures are available for surface or recessed mounting (Fig. 4).

From all of the foregoing, it is obvious that selection of the type of speaker to be used for any job depends upon the conditions which prevail. General selection data given above covers the most common conditions found in commercial and industrial area. But each job has its own peculiarities and requires a careful matching of speaker characteristics to sound requirements. Only experience can provide the fine techniques of selecting the proper type of speaker, and frequently even the most accomplished sound system specialist will have to conduct tests to determine optimum speaker selection and orientation.

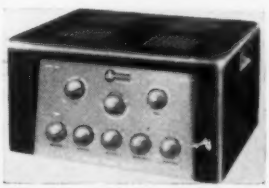
### Number of Speakers

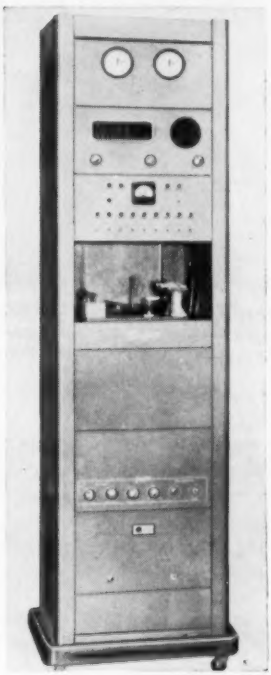
One of the fundamental problems on all sound jobs is determination of the proper number of speakers to do the job. The decision frequently will have to consider initial cost, convenience of installation and service, disturbance objections and architectural, acoustic and aesthetic aspects. Among the latter will be found problems of reverberation, sound absorption and appearance. For experienced sound specialists, the problem boils down to the selection of one of two types of speaker systems which are referred to as a.) high level, b.) low level. In the former type, the sound is projected from one or only a few speakers to cover the complete area. In the latter system, a relatively large number of smaller speakers is evenly spaced throughout the entire area to provide uniform coverage. In the high-level system, the sound level at each speaker is considerably higher than will usually be found in any one of many low-level speakers, and this may cause discomfort to people who are near it. For this reason, railroad stations, airports and hotel lobbies are almost always wired with a low-level speaker system. In large auditoriums, ball parks and theatres, a so-called high-level system is usually preferred since the speakers can be mounted at a distance from the audience to prevent blasting (e.g., on a pole in center field, ceiling height over a prize ring, on the proscenium arch above a stage). In theatres and small auditoriums a high-level system —which features a single sound source —provides an important advantage in that the illusion of sound coming from the lecturer is maintained by adjusting the volume to the lowest possible acceptable level. Voice reinforcement can be provided so that the audience is frequently not aware that a sound system is actually in operation.

Low-level systems obviously are indicated for large offices and in factories or in high-noise areas where it is advantageous to place the speaker in close proximity to the employee. If large horns are located at a distance and operated at the high level required to overcome the noise, the end result may be one which causes discomfort to those closest to the horn. For blanket, uniform coverage of an area, the low-level system will usually receive the nod. A careful consideration of the many factors involved will frequently lead to a combination of the two systems whereby horns are employed at one point to cover a large outdoor area and numerous cone speakers driven at relatively low level to blanket an office, corridor and factory area.

Proper locations of loudspeakers must be carefully chosen. In general, the total number of speakers used in any installation should be more or less equally spaced and mounted in

**FIG. 2 — Three Basic Assemblies of Equipment**





**CONSOLE**—Amplifier, preamplifier, controls, radio tuner, tape recorder, record player, monitor speakers, intercom and phones—mounted in a console cabinet. (above)

**SHELF-MOUNTED**—Complete amplifier and preamplifier on one chassis. For mounting on table or shelf. (top right)

**CABINET RACK**—Amplifier, preamplifier, controls, record player, tone generator, radio tuner, program clocks and monitor speaker—mounted on panels in vertical rack. (right)

strategic positions to provide uniform sound dispersion throughout the area. Any irregularities in the layout of the area should be duly provided for in placement of speakers. Actually, locating and orienting speakers properly requires considerable experience and, as was noted earlier, even the best of sound specialists readily admit that there are times when a number of trial positions must be experimented with to obtain the best locations. Often, after an installation is completed, it will be necessary to add, remove or rearrange loudspeakers.

### *Rules for Speaker Placement*

There are a few rules-of-thumb which can be applied to the problem of locating speakers:

Loudspeakers should be located to provide uniform loudness over the area covered, eliminating "dead" spots and "hot" spots.

In churches, theaters and auditoriums, speakers should be located well forward of the microphone(s) to prevent feedback, characterized by sustained high-pitched squeals when someone talks into the microphone.

Orientation of loudspeakers is important to minimize reverberation (sound bouncing around the interior and producing echo affects).

In theaters, churches and auditoriums, speaker placement should provide the illusion that sound is actually coming from its point of origin, i.e., the screen, the pulpit, the stage.

If the area to be covered by sound is a highly decorative commercial interior, the speakers should be placed with regard to the effect their appearance has on the overall appearance of the interior. In restaurants, theater lobbies and such places, the speakers can be housed in attractive enclosures or concealed behind existing furnishings like large potted plants, thin tapestries or lighting units.

Considerable literature is available from loudspeaker and sound system manufacturers covering specific details on the subject of sound reproducers. Advice on particular problems and engineering cooperation on particular jobs are also offered by the manufacturers.

### *Connecting Speakers to Amplifier*

Whether the sound system is of the simple type employing a single amplifier with a very limited number of loudspeakers or one in which a group of amplifiers feeds varying amounts of power to a large number of loudspeakers, satisfactory operation depends upon an efficient transfer of power from the amplifier to the speakers. An amplifier will deliver maximum power to its load when the impedance of the load equals the amplifier output impedance marked on the output terminal strip. In planning how loudspeakers are to be connected to the amplifier(s), consideration must be given to the output impedance taps (ohms) available at the amplifier, the impedance (ohms) of the loudspeakers and the level at which each speaker is to be driven. For maximum power delivery to the loudspeaker load, the output impedance of the amplifier must be "matched"

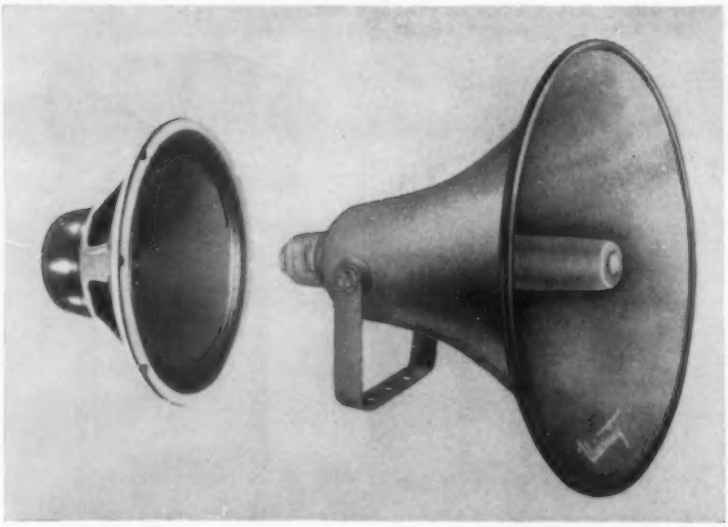


**FIG. 3—TYPES OF LOUDSPEAKERS.** Left: A cone type loudspeaker preferred where music reproduction is a major requirement of the sound system. Right: A trumpet or horn speaker used in high level systems in industrial and outdoor applications.

(i.e., equal) to the load impedance.

There are two methods of obtaining power transfer from the amplifier to the loudspeakers, and at the same time matching impedances to obtain maximum power transfer:

1. Direct wire connection to the single speaker or group of speakers so that the resultant load impedance equals the impedance value across the amplifier terminals.

2. Connection from the amplifier to the loudspeakers through small transformers designed especially for the purpose. Use of transformers greatly simplifies the problem and provides the means whereby different sound levels can be established at different speakers. For instance, in a typical church installation transformers installed at each speaker will permit driving the steeple horns to 50 watts, the nave cone speakers to 5 watts, etc.

### Connection of Speakers

*Direct wire connection of loudspeakers to amplifier* can be used when the speaker hookup is simple and the wire lengths to the speakers are about 200 ft. or less. When the arrangement of speakers is complex and the wire runs over 200 ft. and when it is desired to keep power loss in the transmission line under 15%, transformers are required.

Direct wire connection of speakers to amplifier can be divided into a few simple cases, as follows:

*Single speaker*—If only one loudspeaker is to be connected to the amplifier, simply connect the two wires from the loudspeaker to the two terminals on the amplifier which are marked with an impedance value corresponding to the impedance of the speaker (as given by the speaker manufacturer). Most amplifiers have an output terminal strip with a number of terminals to provide a range of output impedances and these output impedance values have been selected to provide the greatest flexibility in properly matching to a variety of speakers. Usually, one terminal is marked "G" or "C" or "COMMON". This is the ground or common terminal used with one of the other terminals to obtain a particular output impedance value. Other terminals are usually marked "4", "8", "16", "250" and "500". The numbers refer to the amplifier output impedance which is available between each terminal and the common terminal.

In the case of a single 4-ohm loudspeaker which is to be direct-connected to an amplifier, one of the two wires from the loudspeaker would be connected to the "C" or common terminal and the other wire connected to the terminal marked "4". If the speaker had a voice coil impedance of other than 4 ohms (typical impedances are 4, 8, 16), connection would be made between the common terminal and whatever other terminal was marked with a value corresponding to the value of speaker impedance. It should be remembered that connection of a loudspeaker to amplifier terminals which are marked with a value exactly corresponding to speaker impedance means that maximum power will be transferred from the amplifier to the speaker: the speaker is "matched" to the amplifier. In the case where an amplifier has no terminals with value exactly corresponding to the value of speaker impedance, the closest possible match in values should be made. Such would be the case of connecting a 6-ohm speaker to an amplifier on which the closest output impedance was 4-ohm. The speaker wires would be connected to the 4-ohm terminals—the closest possible match. In this case, where the impedance of the amplifier output differs slightly from the speaker impedance, less than maximum power transfer will be obtained, but loss in sound volume as a result will not be serious or even noticed.

*Series speakers*—When more than one loudspeaker is used in a sound system and these speakers are connected in series, the resultant impedance of all of the loudspeakers must be matched to the terminals on the amplifier output strip. The total impedance of speakers connected in series is the sum of the individual impedances of the speakers. Thus, three 4-ohm speakers in series would have a total impedance of 12 ohms; two 8-ohm speakers would have a total of 16 ohms; four 16-ohm speakers, 64 ohms. Of course, it is also possible to have speakers of different individual impedances in series, as: one 4-ohm speaker, one 8-ohm speaker and one 16-ohm speaker—a total impedance of 4 ohms plus 8 ohms plus 16 ohms, or 28 ohms. In the latter case it should be carefully noted that few if any amplifiers provide a 28-ohm output impedance tap and that even if one could be found another problem would exist. The 16-ohm speaker would receive approximately half of the amplifier output; the 8-ohm speaker approximately one quarter and the 4 ohm speaker approximately one eighth. If the installation called for equal sound level at all speakers, a line matching transformer would have to be used at each speaker and wired in accordance with the instructions covered later in this article. In general, the series arrangement of speakers is not recommended since the failure of any one speaker removes power from all.

*Parallel speakers*—To get the total or resultant impedance of speakers connected in parallel, the familiar formula for resistances in parallel is used. This formula is given in basic

electricity courses and is fundamental:

$$\frac{1}{Z_t} = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} \text{ etc.,}$$

in which $Z_t$ is the resultant impedance of the entire group of speakers and $Z_1$, $Z_2$, $Z_3$, etc. are the individual impedances of the speakers. As in the case of series connection, the individual speaker impedances do not have to be the same.

*Series-parallel speakers*—In cases where a number of speakers are hooked up series-parallel, the resultant impedance can be obtained by applying both the series formula and the parallel formula and properly combining them. In all cases, the resultant impedance must match the amplifier output. It should be noted that all impedances can be treated like resistances, making calculations identical to those commonly encountered in practical electrical work.

One of the most important considerations in laying out sound systems is the distribution of power among the speakers. Depending upon the size and type of area each speaker must cover, the speakers will usually require that varying amounts of power be supplied to them. Speakers near a source of noise which must be overridden need more power than those in quiet areas; a single speaker covering a large area needs more power than a speaker covering a small area. By carefully arranging speakers in series, parallel or series-parallel hookups, varying levels of power can be delivered to the speakers. For instance, if a 4-ohm speaker and an 8-ohm speaker are connected in series, the same current would be flowing through each; and because watts = $I^2R$, the 8-ohm speaker would be getting twice as much power as the 4-ohm speaker. When speakers of different impedances are connected in parallel, the speaker with the lowest impedance will get the most power.

### Matching With Transformers

The use of a transformer at each speaker to match the speaker load impedance to the amplifier output impedance offers two important advantages:

1. It prevents excessive power losses in the lines to the speakers.

2. It simplifies distribution of varying power levels to the different speakers, particularly in installations requiring a large number of speakers.

There are two types of line matching transformers used to match speakers to the amplifier (Fig. 5):

1. So-called "constant impedance" or "impedance matching" transformer: These are available in power ratings of 6, 12, and 20 watts (and similar values) and provide a multi-tap primary marked off in impedance values between 500 ohms and 14,000 ohms. The secondary provides one or more values—usually 8 and/or 16 ohms. In one manufacturer's line of transformers, one model provides primary impedance values of 500, 1000, 1500 and 2000 ohms; a second model provides 2500, 3000, 3500 and 4000 ohms; still another makes available 4500, 7000, 10000 and 14000 ohms.

2. "Constant voltage" transformer: In design and performance, this component is a first cousin to the impedance matching transformer and differs essentially in that the secondary is marked in watts rather than ohms and provides for matching to 8 and/or 16 ohm loudspeakers. The primary ties to a 70-volt or 140-volt constant voltage line from the amplifier. One commonly used constant voltage transformer, rated to handle 4 watts of power, provides secondary taps of 4, 2, 1, ½ watt. A larger weatherproof outdoor constant voltage transformer is rated at 20 watts and provides 20, 10 and 5 watts on the secondary. In order to deliver to the speaker the power designated at its secondary tap, the constant voltage transformer primary must always be connected to one of two constant voltage output taps on the amplifier, marked either 70 volts or 140 volts. The latter tap usually appears only on large amplifiers. The decision to employ the constant voltage matching system was adopted by the majority of amplifier manufacturers in recent years and has proved a boon to the contractor and service man since no knowledge of algebra is required to properly install a complex speaker system. The constant voltage system operates electrically in exactly the same manner as does the "impedance matching system" and will unquestionably supercede the older and more cumbersome system when its use has become more widely understood. By employing the constant voltage system, it is possible for an installer to determine simply and quickly the kind of transformer required and the method of connection to be made between the speaker and amplifier.

The constant voltage system is recommended in large multi-speaker installations and greatly reduces the amount of computation necessary to determine proper transformer taps to provide varying sound level outputs. The system also permits changes in the number of speakers without recalculation of impedances and power delivered. Several values of constant voltage have been set: 70 volts, 100 volts, 140 volts, etc. To use the constant voltage system, therefore, the amplifier used must have an output tap marked for one or more of these values (which most amplifiers do provide).

For proper loading, the total power consumed by the speakers must be less than or equal to the amplifier rating. However, the total power handling ca-

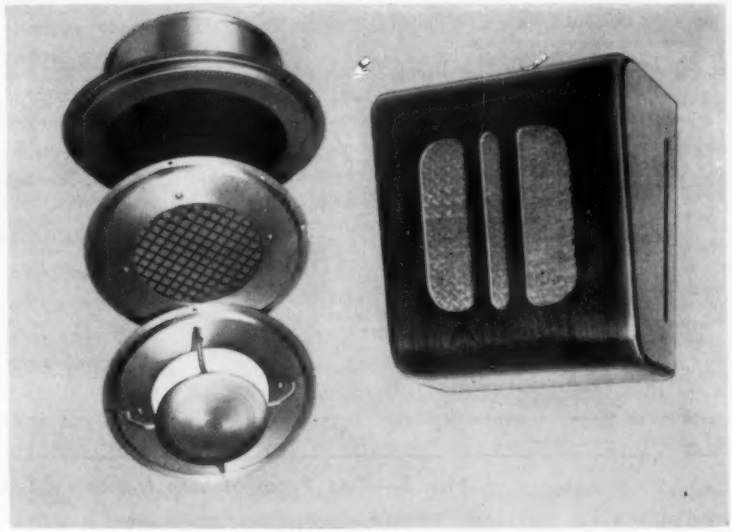


**FIG. 4—BAFFLE ENCLOSURES FOR CONE SPEAKERS.** Left: The elements of a typical decorative metal baffle for recessed ceiling or wall mounting. Right: A typical wood baffle for wall-surface mounting.

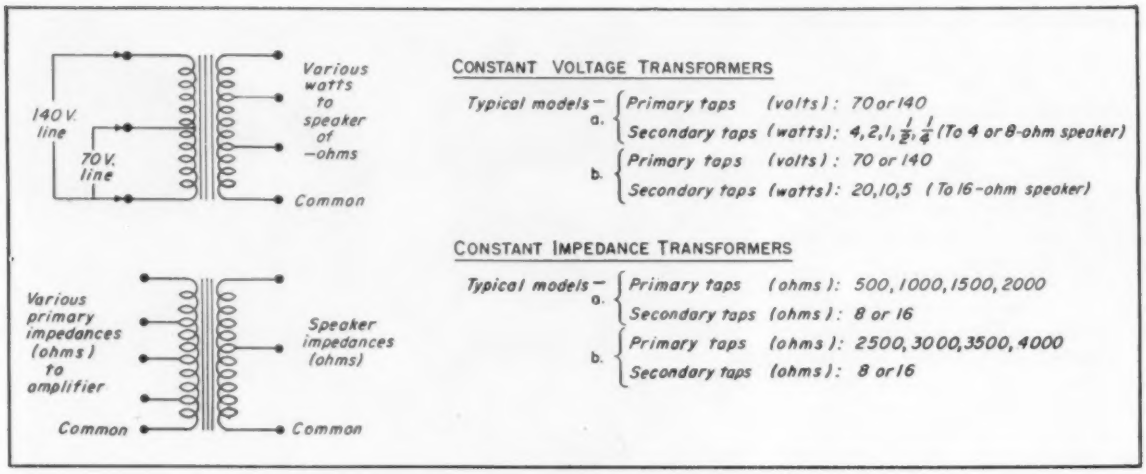

140 V. line
70 V. line
Various watts to speaker of —ohms
Common
CONSTANT VOLTAGE TRANSFORMERS
Typical models — a. Primary taps (volts): 70 or 140
Secondary taps (watts): 4, 2, 1, ½, ¼ (To 4 or 8-ohm speaker)
b. Primary taps (volts): 70 or 140
Secondary taps (watts): 20, 10, 5 (To 16-ohm speaker)
Various primary impedances (ohms) to amplifier
Common
Speaker impedances (ohms)
Common
CONSTANT IMPEDANCE TRANSFORMERS
Typical models — a. Primary taps (ohms): 500, 1000, 1500, 2000
Secondary taps (ohms): 8 or 16
b. Primary taps (ohms): 2500, 3000, 3500, 4000
Secondary taps (ohms): 8 or 16

**FIG. 5—Two Types of Line Matching Transformers**

pacity of a group of speakers should be equal to or slightly greater than the amplifier rating, to prevent over-driving of the speakers and possible damage.

Since the constant voltage transformer has secondary taps marked in "watts", it is only necessary to select a transformer to match the impedance of the speaker it will supply. After the speaker is connected to that transformer secondary tap which delivers the desired power, the primary of the transformer is connected to the constant voltage line. The amplifier power output is distributed among a number of speakers, each with a similar transformer hookup and all in parallel on the line, so that the total watts taken from the transformers is equal to or less than the amplifier rating. See Fig. 6.

One very important advantage of the constant voltage system lies in the fact that a more powerful amplifier may be substituted in an existing system at any later date without the recalculation of the load and source impedances — and the necessity for changing taps on the line matching transformers. So long as the total power consumed by the loudspeakers is equal to—or less than—the amplifier rating, a proper match will always exist. In the constant voltage system, loudspeakers (through their constant voltage transformers) are connected across the transmission line with the same ease that electric lights or appli-

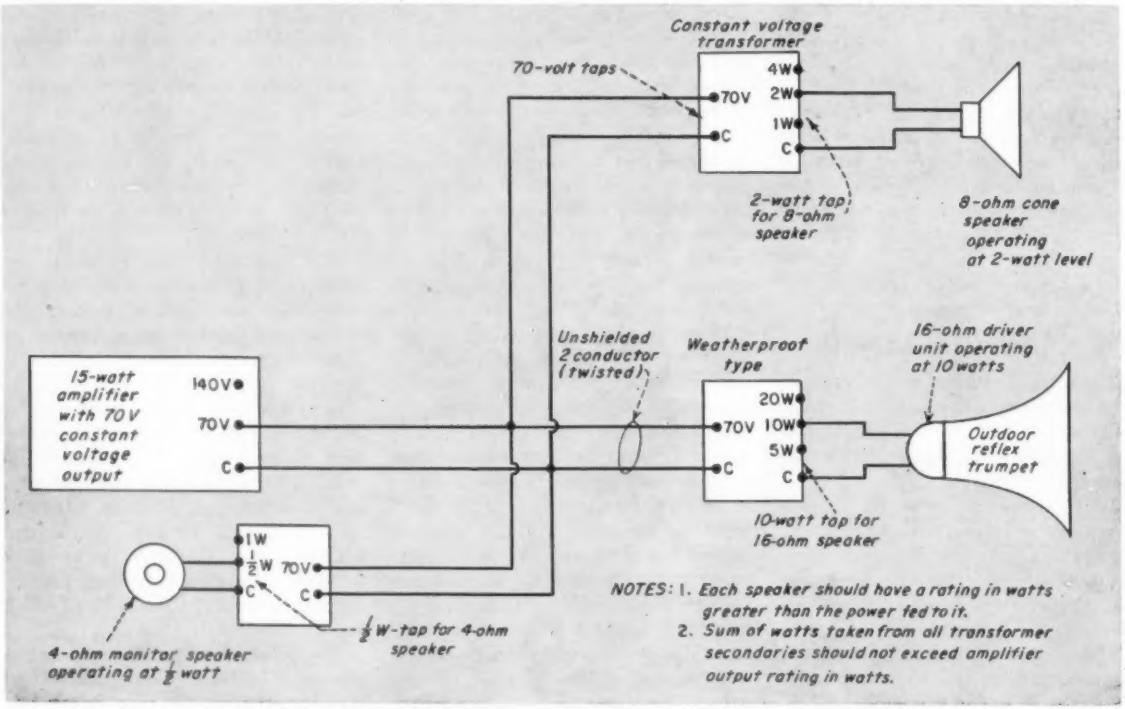



**FIG. 6—Speaker Hookup with Constant Voltage Transformers**

ances are tied on to a power line, up to the capacity of that circuit.

In the impedance matching system which preceded the advent of the constant voltage matching system, an amplifier providing 250 and/or 500-ohm taps on its output strip was connected via a speaker line to loudspeakers through impedance matching transformers which we have described above. The main idea in using this system is to see that the parallel hookup of transformer primaries has a resultant impedance which matches one of the amplifier output taps. As in the case of the constant voltage transformer, the component must be rated to handle an amount of power at least equal to the power consumed by the loudspeaker. The primary impedance tap (which is connected to the amplifier) determines the amount of power which will be delivered to the loudspeaker, and to simplify installation a relatively wide range of taps is available. A simple example will probably serve to illustrate the method in which the impedance matching system is employed. Let us assume that an amplifier with a 500-ohm output tap is to be connected to two remotely located 8-ohm loudspeakers. To match the 500-ohm amplier impedance, it will be necessary for us to use two impedance matching transformers which provide 1000-ohm taps and which are rated to handle at least half the amplifier output power. The 8-ohm secondary tap on each transformer is connected to each loudspeaker voice coil. The two 1000-ohm transformer primary taps are then paralleled—resulting in a 500-ohm impedance line—and connected to the 500-ohm tap on the amplifier. If four loudspeakers are to be connected in a similar manner, then transformers with 2000-ohm taps would be used and connected in parallel to the 500-ohm taps. See Fig. 7.

*Phasing Loudspeakers:* After the sound installer has decided upon the method of matching the loudspeakers to the amplifier (with or without transformers), he must give careful consideration to phasing the loudspeakers. This must be done to prevent sound from any one speaker cancelling out sound from another speaker to create a dead area between both. This applies to reflex trumpets employing driver units as well as to the more commonly used cone loudspeakers. Speakers facing in the same direction are properly phased when the connections to the voice coil (whether in series or parallel) are made in such a manner that at any one instance all diaphragms are moving in the same direction (i. e., in or out). Phasing is not a serious consideration where two or more loudspeakers are a considerable distance apart or mounted back-to-back pointing in opposite directions. As the speakers are brought closer together or to a smaller angular relationship, however, the necessity for in-phase operation becomes increasingly important. The sound specialist with long experience can usually phase closely spaced loudspeakers by ear. This is frequently done by temporarily mounting the speakers face to face, introducing a 50 or 60 cycle note into the system and noticing the results. If the low frequencies are cancelled out, the speakers are in phase; if the low frequencies do not cancel out in this test, the speakers are out of phase and the voice coil leads to one of the loudspeakers should be reversed. Another simple phasing technique consists of connecting a very low voltage battery ($1\frac{1}{2}$-volt dry cell—$4\frac{1}{2}$-volt battery) across the voice coil of each loudspeaker in turn. The diaphragm will move outward when the positive side of the battery is connected to one of the two voice coil terminals. The loudspeakers may be checked in this manner and the voice coil leads marked accordingly. If loudspeakers face in the same direction, they should be wired for in-phase operation. If, however, loudspeakers are mounted facing each other they should be out of phase.

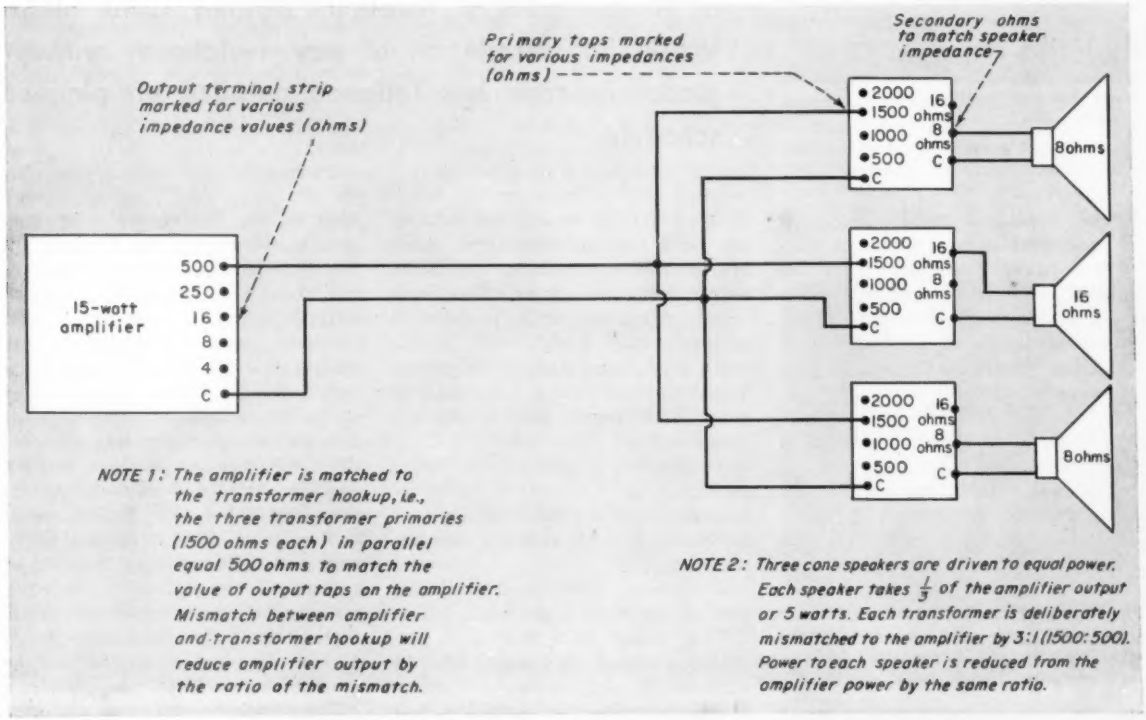
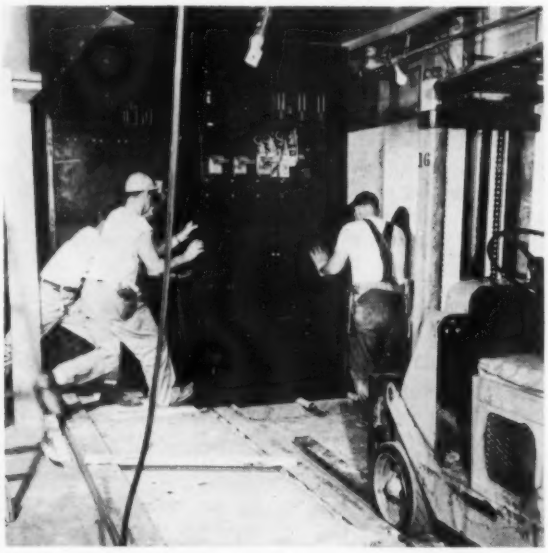

Primary taps marked for various impedances (ohms)
Secondary ohms to match speaker impedance
Output terminal strip marked for various impedance values (ohms)
15-watt amplifier
500
250
16
8
4
C
2000
1500
1000
500
C
16 ohms
8 ohms
C
8ohms
16 ohms
NOTE 1: The amplifier is matched to the transformer hookup, i.e., the three transformer primaries (1500 ohms each) in parallel equal 500 ohms to match the value of output taps on the amplifier. Mismatch between amplifier and transformer hookup will reduce amplifier output by the ratio of the mismatch.
NOTE 2: Three cone speakers are driven to equal power. Each speaker takes 1/3 of the amplifier output or 5 watts. Each transformer is deliberately mismatched to the amplifier by 3:1 (1500:500). Power to each speaker is reduced from the amplifier power by the same ratio.

**FIG. 7—Speaker Hookup with Constant Impedance Transformers**

**OLD SWITCHGEAR,** as it looked before changeover started. Note narrow passageway. Preliminary work including removal of all possible bolts, panels, was done prior to holiday weekend.



**REMOVAL OF OLD** cubicles, after disassembly of connecting bus work, was quick. Units were rolled off channel-iron base into narrow passageway in front of switchgear line.

## *TEAMWORK SPARKS*

# Quick Switch to More Capacity

**at North American Aviation's Downey, Calif. plant. Week-end installation of new switchgear without production-time loss followed detailed pre-planned schedule.**

**By Neil Currie,**
*Electrical Engineer*
*North American Aviation, Inc.,*
*Downey, Calif.*

THE headaches of installing new switchgear to meet increased electric power needs for plant expansion are numerous when the job must be done without even one hour loss in production time. That aspirin is far less helpful than an orderly plan of operation methodically carried out was demonstrated not long ago at North American Aviation's Downey, Calif. plant.

This was the problem faced by the N.A. electrical department. A utility expansion program, including increased capacity of the distribution substation serving the plant, threatened to increase short circuit values at the plant's 2,300-volt bus to 65,000 kva, with an ultimate of 100,000 kva possible at a future date. The interrupting capacity of existing switchgear serving eight plant feeders was only 25,000 kva. The transformer bank at the plant was increased from 4,500 kva, to 6,000 kva. and another 12-kv supply feeder was added. Two additional feeders were added in the plant to serve power loads.

An engineering study of the project suggested replacement of existing gear. This would save money and down-time by:

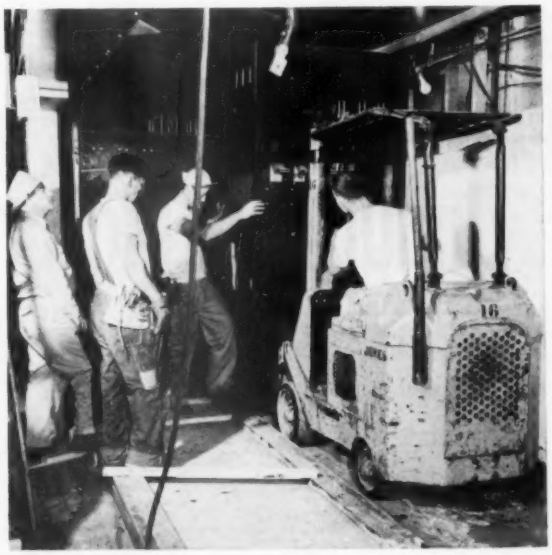
1. Eliminating splicing of feeder cables.

2. Reducing to a minimum the costs of incoming and outgoing bus installation.

3. Avoiding enlargement or relocation of the main vault.

Even though space limitations precluded working the board hot, the engineer decided to take advantage of these savings by installing new gear. Equipment specifications were open to any bidder but were very specific about matching existing bus ducts and feeders. Space limitations and requirements were in strict detail. Two existing sections of synchronous motor controllers were to remain and the new board had to match these cubicles. After careful study, the engineer selected fused interrupter switch equipment. This cut the entire cost of purchase and installation of 11 tons of switchgear to considerably less than $40,000, about half of what other proposals would have cost. The new gear consisted of a main oil circuit breaker, metering cubicle and ten fused load interrupter cubicles for secondary circuits as well as fused protection for the synchronous motors.

The complete installation was carefully planned and pre-scheduled so



**FORK LIFT TRUCK** then maneuvered into position, picked up the old cubicles and traversed the 150-ft long passageway to deposit units at predetermined spot.

**TIGHT SQUEEZE** due to space limitations made going rough in some places. Here, truck carried last cubicle past synchronous motor controllers which remained in place.

the actual changeover could be made over a 3-day weekend. Three days prior to arrival of the gear, the electrical contractor sent a skeleton crew for preliminary work. This involved provision for grounding, stripping removable panels from the old cubicles, and removal of every nut and bolt possible. An accessway to the switchboard through 150 ft of laboratory and experimental area was cleared. When the new switchgear arrived, the engineer personally checked every fuse, switch, bus splice, door fit and breaker. He even counted nuts and bolts to make certain no parts would be missing when the equipment was installed. By Friday preceding the July 4th weekend all work that could be done in advance had been completed.

The next day the race against the clock began. The electrical contractor had just three days to remove the old gear, transport, set and connect the new cubicles, connect existing feeders and busses and check out and test the installation. The following chronological report of the changeover sequence operations indicates the degree of pre-planning and coordination that made the job click.

*Saturday*

*7:00 AM*—Temporary generator furnished light for the cutover and power for essential laboratory circuits. The utility company crew cut off all plant power, revised their metering system and reworked some of their bussing.

*7:25 AM*—The board was "killed" and removal work started immediately. Each section of old switchgear was removed, one by one, with a fork lift truck.

*9:35 AM*—The main switchboard was by-passed and temporary power was restored to much of the plant.

*1:30 PM*—The floor was clear of old switchgear and work began on setting the new cubicles.

*3:05 PM*—The first section of new switchgear was in place.

*8:30 PM*—All nine new sections of switchgear were in place.

*Sunday*

The contractor's mechanics spent *12 hours* bolting panel sections together, bolting bus splices, splicing the new board to the existing bus ducts and installing the fuses in the existing synchronous compressor cubicles.

*Monday*

*6:00 AM*—Work began and the engineer inspected all splices one by one. All panel sections were closed up.

*2:30 PM*—The utility company truck arrived to make connections.

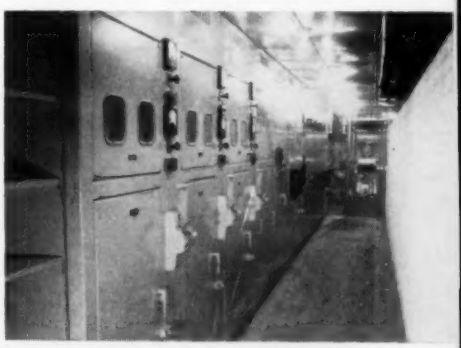
*3:00 PM*—The plant was back on generator power.

*3:23 PM*—The utility company breakers were closed and the busses were hot.

*3:25 PM*—The electrical contractor closed the main breaker on the new switchgear, then energized each branch circuit in turn.

Tuesday morning, following the 3-day holiday, the plant went back in operation as if nothing had happened.

**FIRST SECTION** of new switchgear was in place less than eight hours after changeover began. Eight additional cubicles were set in less than six hours. Next came the job of making all bus and circuit connections.

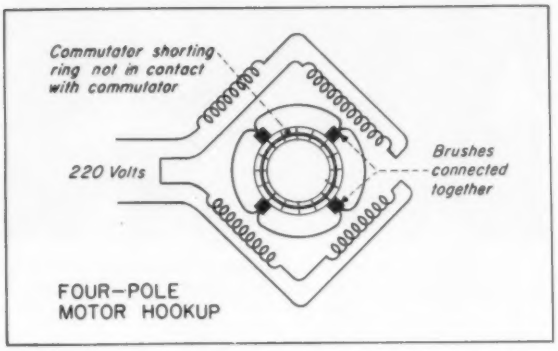


**NEW SWITCHGEAR** was connected and ready to operate less than 60 hours after changeover began. New higher interrupting capacity cubicles take same space as the old 25,000-kva units; protect feeders ranging from 400-amp to 600-amp size.

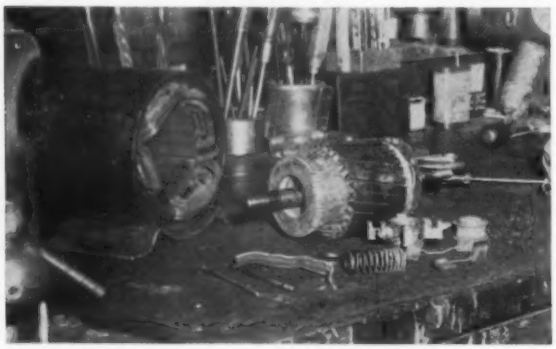
AT THE TEST BENCH—13

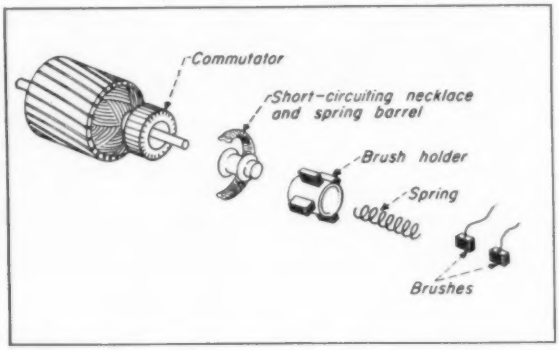
# Checking Repulsion-Start Induction Motor

**By Walter J. Prise,** Chief Engineer,
Queens Electric Motors, Inc., Jamaica, N. Y.

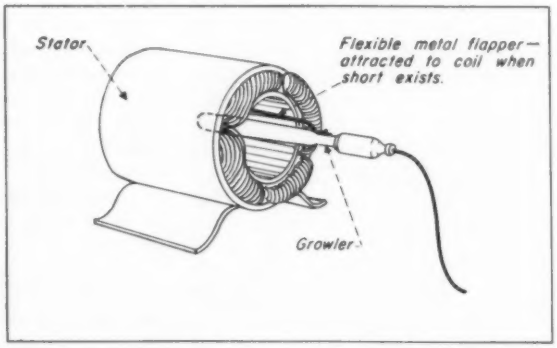



**STEP 1. Checking construction and hookup of a repulsion-start induction motor.** A clear understanding of the action which takes place in a repulsion-start induction motor can be had by disassembling the motor. Remove the end bells and take the rotor out of the stator. As shown, the brushes should be riding on the commutator and the short-circuiting ring should be open.



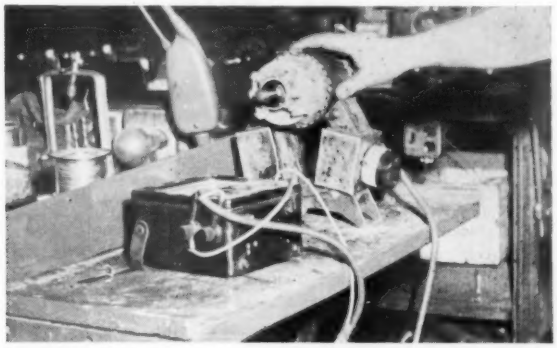


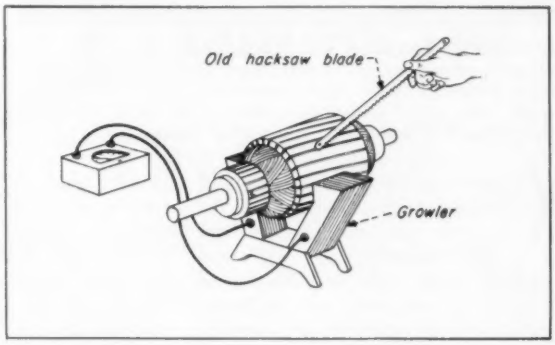

**STEP 2. Disassembling and examining the brush-and-shorting arrangement on the commutator end of the rotor.** Take the assembly apart, noting each of the pieces: the centrifugal switch, brush-holder, spring, short-circuiting bushing and necklace and the brushes. Operation of these parts is simple: when motor comes up to speed, the centrifugal switch, in one operation, disconnects brushes from the commutator and moves sliding ring forward where it presses necklace in contact with inside of commutator bars.



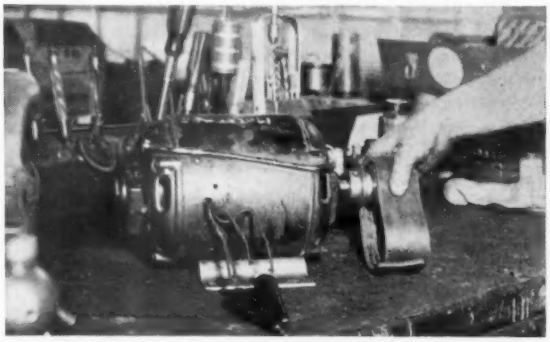

**STEP 3. Determining condition of stator winding.** Use a growler to check for shorted windings and other faults in the stator of the motor. The growler shown here can be moved around the inside of the stator and is equipped with a flapper which is attracted to the growler coil when a fault exists.

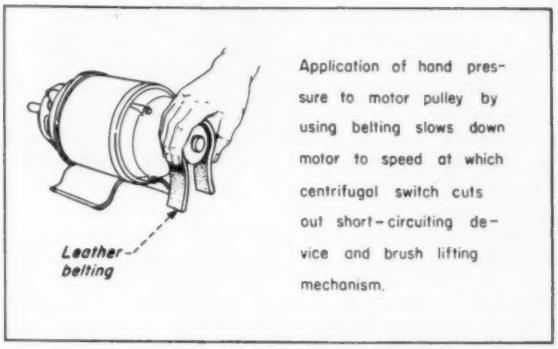
The repulsion-start induction motor is a single-phase commutator-type motor which operates as a repulsion motor during starting and an induction motor after it comes up to speed. The motor has an armature winding and a commutator like a series ac motor. During starting, brushes ride on the commutator and are externally connected to each other, as in a straight repulsion motor. The ac supply line is connected to the stator winding. As torque is developed, the motor starts to come up to speed. At a predetermined speed, somewhere around 70% of synchronous speed, a centrifugally-operated mechanism moves a short-circuiting ring against the commutator bars, short-circuiting the commutator bars. The brushes may or may not be left riding on the commutator after the motor comes up to speed. Most repulsion-start motors combine a brush-lifting mechanism with the short-circuiting device, to minimize brush wear and noise during operation. In either case, the short-circuited commutator effects straight induction motor operation. At speeds above the speed at which the centrifugal device shorts the commutator bars, the armature winding is effectively a simple squirrel-cage rotor.



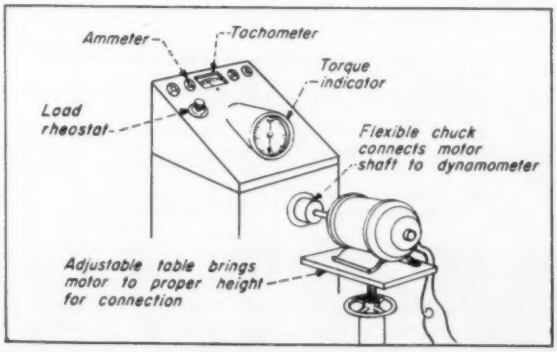



**STEP 4. Testing for faults in the armature.** Use a bench type growler, which can be adjusted to accommodate rotors of various diameters, and an old hacksaw blade. As shown, an ammeter is connected in series with the growler to give an additional indication of short in armature winding.




Leather belting
Application of hand pressure to motor pulley by using belting slows down motor to speed at which centrifugal switch cuts out short-circuiting device and brush lifting mechanism.

**STEP 5. Checking operation of centrifugal switch and short-circuiting device, after damaged parts are replaced and/or other repairs have been made.** Start motor and let it come up to speed. Then, using a length of leather belting for protection as shown, apply hand pressure to the motor pulley to slow the motor down to a speed at which the centrigugal switch will cut out. By experimenting, it can be determined if the shorting and brush-lifting action is taking place properly and at the right speed. Spring tension and condition of bearings can be observed during this procedure.




**STEP 6. Testing motor torque and load current.** For this test, a dynamometer is used. The motor is connected to it and driven as shown. A wall-mounted chart informs the test man of starting and normal torque for motors of different horsepower. An ammeter is used to check current. The motor is then loaded by a rheostat; torque and full-load current are again checked.

**BRIGHTNESS RATIO** of ceiling and recessed lighting is minimized by employing light-colored terrazzo floor and walls with highly reflective finish. Each fluorescent assembly accommodates eight 48-in deluxe cool white slimlines while round downlights take a standard 300-watt IF lamp.

# Custom Lighting for a Bank

KEYSTONE of the modern interior of the new midtown branch of the Emigrant Industrial Savings Bank is a high intensity, low brightness lighting system that provides seeing comfort to customers and employees and attracts the attention of passers-by through the oversize windows along both sides of the L-shaped banking area.

Lighting for the tellers' wickets which run along the inner walls of the "L" is derived from two continuous parallel rows of alternating 8-ft slimline troffers and recessed square incandescent units. Designed to provide a maintained level of 80 footcandles, this installation still delivers close to the initial 100-footcandle after more than five months of operation.

Troffers are designed to take four 48-in. slimline lamps, tandem-mounted in two rows. These units employ a Corning No. 70 lens and a flat reflector of baked white enamel. The troffers, and all other fixtures on the job, were made by Eastern Lighting Products Corp. according to designs prepared by the firm of Edward E. Ashley, consulting engineers for the entire electrical installation.

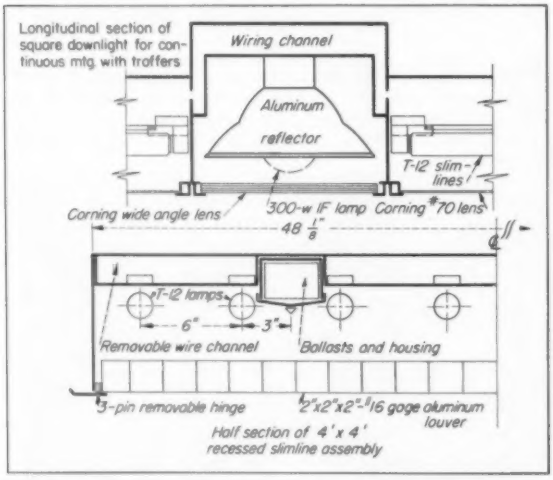
The recessed square incandescent units which are installed alternately with the troffers utilize a 300-watt PS-35 lamp as their light source. A specular aluminum reflector and a Corning wide angle lens distribute the incandescent light efficiently so as to balance and blend with the colder fluorescent illumination. Since these units are 3¼ in. deeper than the adjacent troffers, it was necessary to build an offset wiring channel into them in order to provide a continuous raceway for wiring.

Lighting for the public area and officers' desk space is derived from a combination of 4-ft square recessed slimline assemblies and open-bottom circular downlights. Initial lighting intensity was 75 footcandles.

The fluorescent units house eight 48-in. slimlines on 6-in. centers. Lightweight aluminum louvers simplify both relamping and cleaning operations. Ballasts are enclosed in two parallel channels.

The circular downlights employ an ellipsoidal Alzak reflector with a standard 300-watt lamp.

The complete renovation of the interior, which included installation of a hung ceiling, air conditioning and a public address system, was accomplished within five months. S. J. O'Brien, Inc. were the electrical contractors on this project.



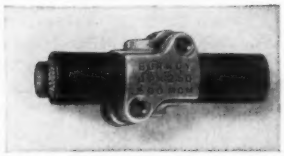

**FIXTURE DESIGNS** were calculated to meet structural conditions and to provide optimum performance with simplified maintenance. Downlight has offset wiring channel to afford continuous raceway with shallower troffers. Recessed slimline assembly for lighting public area has ballast housing projecting in between lamps because of space limitations.

**LARGE WINDOWS** along both sides of the L-shaped bank are at sidewalk level, afford pedestrians an excellent view of well-lighted interior. Maintained intensity in tellers' area is 80 footcandles, public space will receive a minimum of 55 footcandles. Signs on columns are illuminated during rush periods.

# 5 connections

END TO END

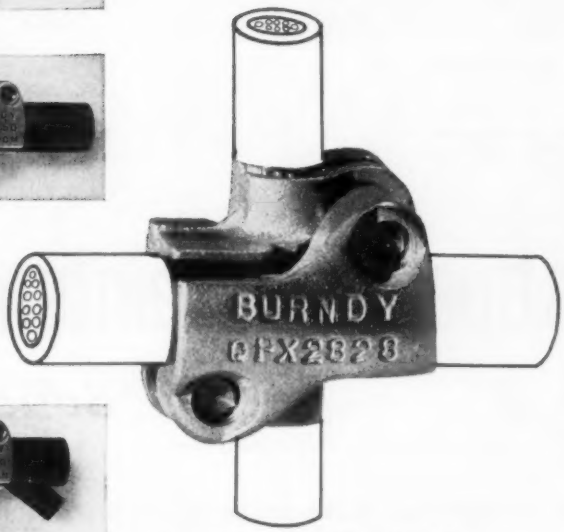
TEE

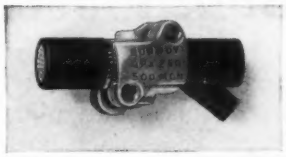


PARALLEL

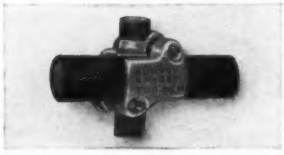
# 1 connector

## Versitap



TAP



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See Burndy Catalog 52 for details.

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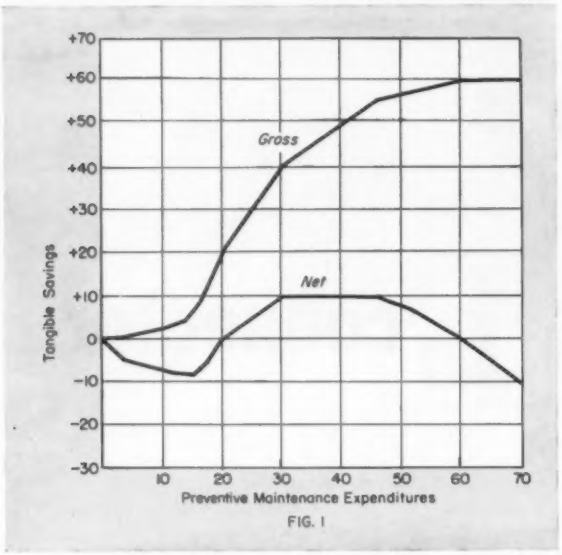

FIG. 1

**INDUSTRIAL MAINTENANCE** costs should ideally fall in zone between 20 and 60, where net savings are tangibly evident. Insurance companies and public utilities both prefer zone around 60, where actual savings are reduced but where safety and public relations are at a maximum level.

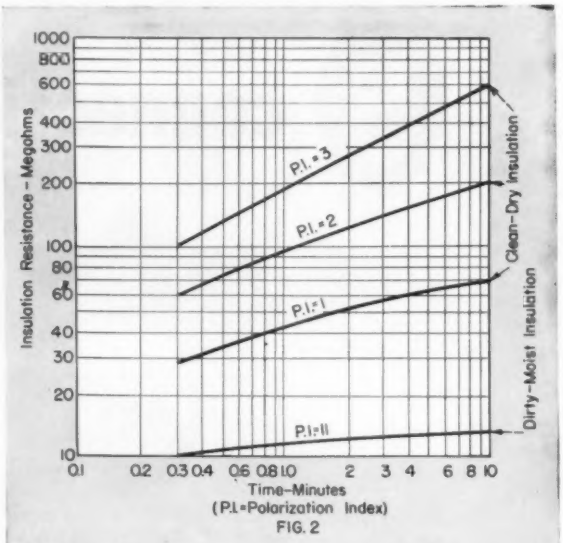

FIG. 2

**TYPICAL CURVES,** showing variation of insulation resistance with time for Class B insulated ac armature windings, indicate that duration of tests have marked influence on values when insulation is dry, clean and healthy, although values taper off rapidly when insulation is moist and dirty.

# Investment in Maintenance

## . . . Basic Production Factor

**Sound economics prove value of industrial housekeeping when trained men intelligently service electrical equipment, then analyze data obtained with proper measuring instruments.**

**By E. B. Curdts,**
*Application Engineer, James G. Biddle Company, Philadelphia, Pa.*

A PREVENTIVE maintenance program can be defined as one in which equipment is inspected, tested and reconditioned at regular intervals to prevent failure in service and to retard deterioration. The interval is chosen as a result of experience, based on the character of the equipment, the service conditions to which it is subjected, and the importance of its function in the production process.

Maintenance of industrial electrical equipment, like other production facilities, is primarily a problem of business economics. It can be divided into two parts for general consideration: preventive maintenance, and trouble shooting. And the expense of the first part definitely influences the reduction of the second. That is, as preventive maintenance is encouraged, trouble shooting during emergency periods become less frequent or extensive.

The extent to which preventive maintenance should be practiced can be determined by: (1) making an engineering and common sense study of the past experience of the individual plant and its present condition; (2) acquiring knowledge of what can be done to detect and prevent equipment deterioration; and (3) balancing the cost of applying certain preventive maintenance measures with the total tangible and intangible costs of maintaining the equipment as in the past.

Graphic explanations of how a shift in emphasis may affect maintenance costs are shown in Fig. 1. The management may be reluctant to consider a preventive maintenance program of any kind for fear that it will fall in

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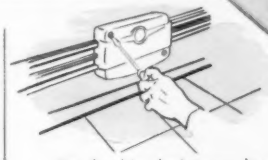
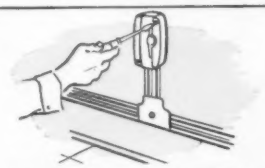
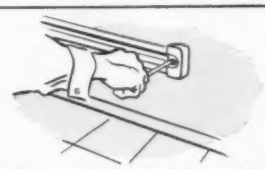


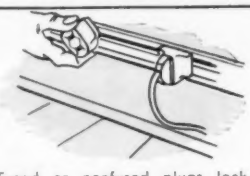
The feed-in device can be used as either an end or a center feed. Electrostrip is perfect for homes, hotels, offices, stores, institutions.



For modernization, the feed-in device can be connected to existing wall outlets. No replastering or "wire-fishing" is necessary.



End caps halt runs of Electrostrip wherever desired. Absolutely safe, the strip is rated at 20 amps, 125 volts. It is listed by Underwriters'.



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## Investment in Maintenance

Starts on page 96

the zone between 0 and 20. The competent plant engineer will strive to keep it in the zone between 20 and 60. Public utilities may, as far as their generation and distribution facilities are concerned, prefer to work in the zone around 60 because of the intangible benefits derived from good public relations. Insurance companies will also encourage working in this same zone so that rates may be reduced to the lowest possible level.

The maintenance of the strictly mechanical parts of electrical apparatus, such as bearings and gearing in rotating machinery, does not usually present a serious challenge to the ordinary maintenance mechanic. It is rather the mechanical aspects of insulating and current-carrying components that suffer from lack of planned attention and care. Such things as binding bands in rotating windings, armature slot wedges, field poles and spools, collector rings, commutators, brush rigging and end-turn cording, all in rotating apparatus, do not always receive by well-trained personnel the periodic inspections they deserve. Apparatus such as transformers and switchgear constitutes a similar problem. Mechanical strains upon fragile insulation, corrosion in free-breathing transformers, poor gasketing conditions in liquid-filled or weatherproof electrical apparatus are all threats to production continuity since they may result in electrical failure.

### *Housekeeping Important*

One of the things that should be dwelt upon at this point is apparatus cleanliness, otherwise known as "good housekeeping" which, although a commonplace subject, does rank high in importance when considering reasons for the deterioration and failure of electrical equipment. The word "cleanliness" is meant to include all foreign contaminating matter, both liquid and solid, which may affect the condition of apparatus.

More modern totally or partially enclosed electrical devices, and recent developments in synthetic impregnating materials, have given the plant engineer a means of combating the influence of contamination in cases where obsolescence of retooling give him the opportunity to purchase new equipment. However, even such modern devices require "good housekeeping" for best performance.

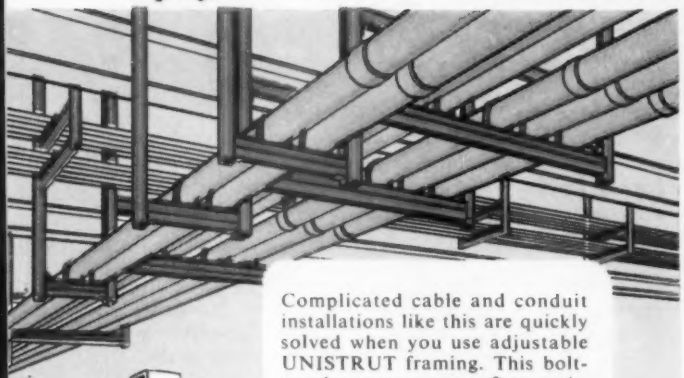
As well as alterations to protect the equipment, remedial measures involve the very simple expedients of the free use of wiping cloths, compressed-air, and liquid solvents, together with adequate drying and baking methods, the use of modern varnishes, and most important, a well-trained, conscientious maintenance department. These measures are important for purposes of inspection, as well as for prolonging the life of mechanical and insulating components. Cleanliness can also be important

**CONTINUITY OF PRODUCTION** can be greatly promoted if accurate insulation resistance measurements are taken regularly. Manual maintenance and visual inspections are definitely essential and helpful, yet internal conditions of insulation can only be ascertained with meters, instruments and testing devices.

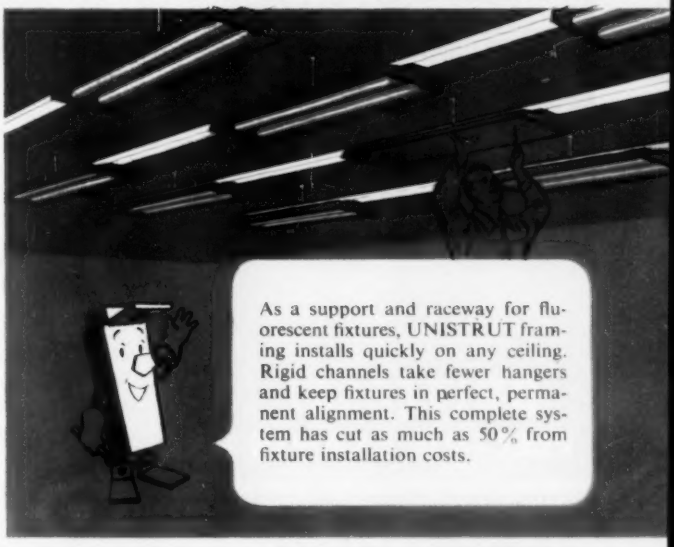
# "The Sky's The Limit"

—when you build with UNISTRUT®

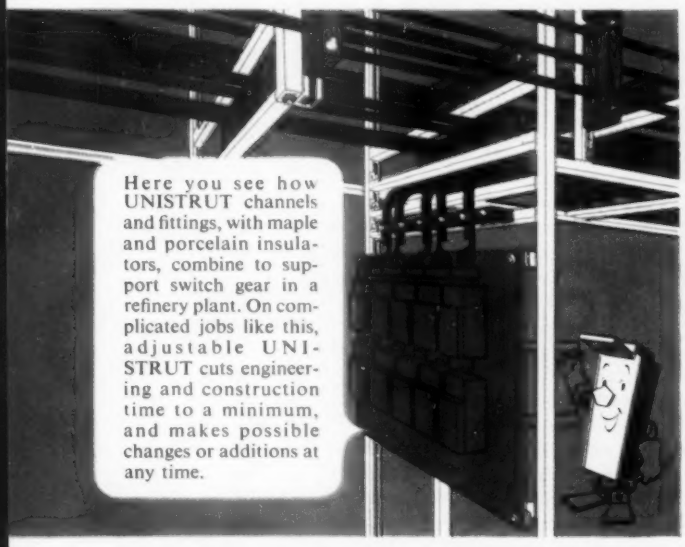
## Mr. Strut shows how flexible UNISTRUT® framing saves time and dollars on electrical supports



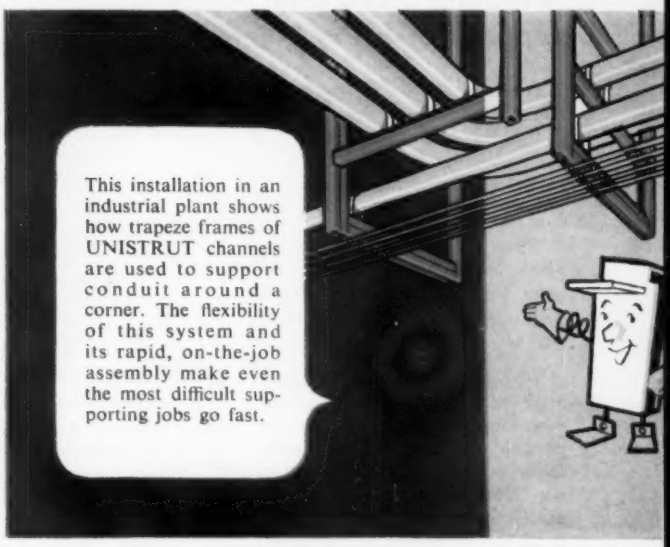
Complicated cable and conduit installations like this are quickly solved when you use adjustable UNISTRUT framing. This bolt-together system goes up fast, on the spot without welding or drilling. Adjustments are made by loosening a bolt—as work progresses or any time later!



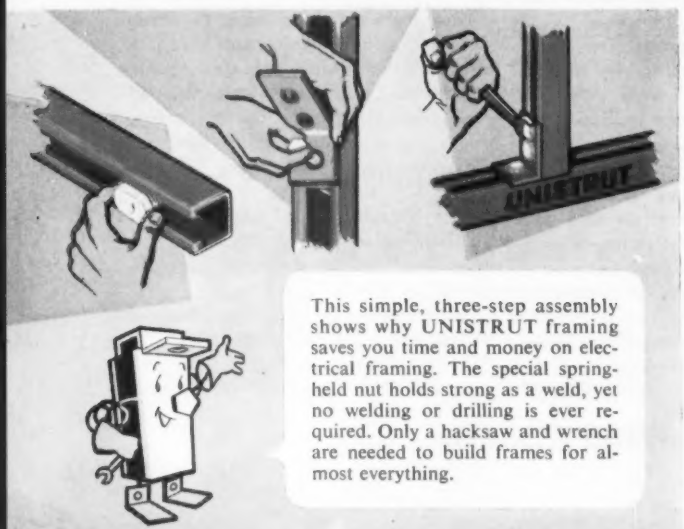
As a support and raceway for fluorescent fixtures, UNISTRUT framing installs quickly on any ceiling. Rigid channels take fewer hangers and keep fixtures in perfect, permanent alignment. This complete system has cut as much as 50% from fixture installation costs.



Here you see how UNISTRUT channels and fittings, with maple and porcelain insulators, combine to support switch gear in a refinery plant. On complicated jobs like this, adjustable UNISTRUT cuts engineering and construction time to a minimum, and makes possible changes or additions at any time.



This installation in an industrial plant shows how trapeze frames of UNISTRUT channels are used to support conduit around a corner. The flexibility of this system and its rapid, on-the-job assembly make even the most difficult supporting jobs go fast.




This simple, three-step assembly shows why UNISTRUT framing saves you time and money on electrical framing. The special spring-held nut holds strong as a weld, yet no welding or drilling is ever required. Only a hacksaw and wrench are needed to build frames for almost everything.

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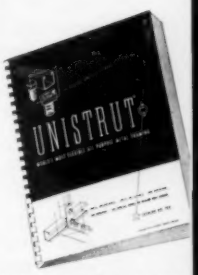


*U. S. Patent Numbers*

| | | | |
|---|---|---|---|
| 2327587 | 2541908 | 2329815 | 2345650 |
| 2363382 | 2696139 | 2380379 | 2405631 |

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## Investment in Maintenance

.....Starts on page 96

from a mechanical point of view. This is particularly so in the case of rotating electrical apparatus, such abrasive things as coil dust causing commutator and bearing troubles.

This matter of cleanliness is important for another reason. The operating temperature, and consequently the life of organic insulating materials in electrical devices, is usually dependent upon the free circulation of the medium for convection cooling, together with heat radiation and conduction. In the case of air-cooled equipment, air passages and surfaces throughout the structure must be kept clean if the equipment is to perform at minimum temperatures. In the case of liquid-cooled equipment, such as oil-filled transformers, the oil ducts and surfaces must be kept free of sludge as well as keeping the tanks and radiators free of non-heat-conducting lint and dirt.

### *Engineered Cleanliness*

Although the cleaning expedients mentioned are very simple in themselves, they do not always bring effective results. This is because of inadequate supervision in some instances, and the difficulty of gaining cleaning access to remote areas, particularly in motor windings.

Further, the foreign matter which may be deposited on or drawn into electrical equipment is usually either electrically conducting in itself or made conducting by its chemical union with other matter. Or, it may be non-conducting in itself but act as a vehicle for conducting matter. Examples of conducting materials are carbon dust and metallic particles. An example of a non-conducting substance which becomes conducting by chemical reaction is pure water. Examples of non-conducting substances which may become vehicles for conducting matter are lubricating oil and cotton lint.

Many of these substances not only provide conducting paths over insulating surfaces, or through insulation fractures, but destroy insulation by chemical reactions as well. An example of this is the effect of lubricating oil on rubber insulation. This destruction by chemical reaction also sets the stage for the penetration of conducting substances through the volume of otherwise impervious insulation materials.

All these conditions of uncleanliness cause leakage currents over the surfaces and through the volume of insulating materials, eventually causing localized leakages resulting in failures, either by carbonized paths, unbalanced voltages to ground, or by a reduction in dielectric strength.

It must be remembered that inorganic insulation materials can also fail electrically as a result of uncleanliness. Materials such as mica or porcelain may flash-over or breakdown because of the contamination of their surfaces, or contamination of fractures resulting from mechanical stress.

### *Measured Resistance*

There are two ways open to the plant maintenance engineer in judging the state of cleanliness and extent of deterioration of the insulation of electrical equipment in his charge. One is visual inspection, and the other is measuring its insulation resistance. Both are necessary, one supplementing the other.

One of the great advantages of the insulating resistance test is that it reveals uncleanliness or deterioration that is not visible to the eye. Another is that it serves as a check on the thoroughness of the cleaning and reconditioning operations. There have been numerous cases where persistent and well-supervised compressed-air cleaning operations have, in an effort to raise insulation resistance values, resulted in opening up air passages that had been blocked for years.

### *Data Interpretation*

The relative value of insulation resistance is the most reliable and conclusive measure of the presence of contaminants. However, very few measurements, if any, are conclusive unless all variable influences are taken into consideration, and insulation resistance measurements are no exception. As in other measurements, they must be interpreted in the light of sound technical knowledge to reach their maximum usefulness. There is a definite trend towards this view. Some of the things about to be mentioned may seem elementary, but are oftentimes neglected, with the result that interpretation is sometimes difficult.

For a plant engineer or his subordinate to take full advantage of insulation resistance measurements, the following briefly expressed points should be kept in mind:

1—A knowledge of the past history of the particular apparatus is helpful. Such information as its insulation resistance value at room temperature

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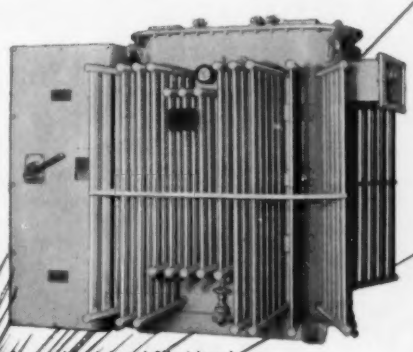

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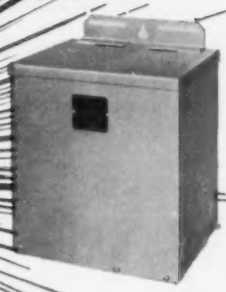

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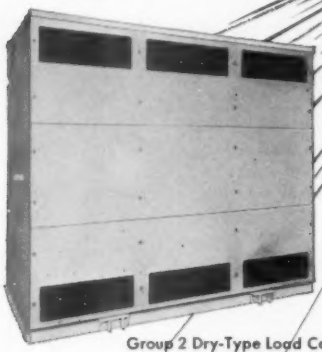

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## Investment in Maintenance

. . . . . Starts on page 96

when new, clean and dry, and its operating and repair record, provides a basis for judging the amount of reconditioning work necessary.

2—The fact that temperature has a marked influence on the resistance of insulating materials. For this reason, all measurements should be made at a base temperature, preferably a few degrees above ambient temperature if practical, or the insulation resistance values corrected to a base temperature before interpretation.

3—That humidity may have a marked influence on the insulation resistance, if the temperature of the apparatus has been allowed to drop to the dew point temperature preceding the test, or if the apparatus has been standing idle for some time prior to the test. In the latter case, it is the absorption of moisture into hygroscopic insulating material as a result of the ambient vapor pressure, which may occur even though the insulation temperature has not dropped to dew point. These may be superficial conditions that can be eliminated by a small amount of heat or air circulation.

4—Recognition of the fact that leakages over terminals and other surfaces may give misleading results, and that these possibly normal leakages may sometimes be excluded from the measurement by the use of the test instrument guard circuit.

5—The fact that duration of the test voltage has a marked influence on insulation resistance values if the insulation is clean, dry and healthy. This phenomenon, known as dielectric absorption, is made use of in modern practice in the form of a time-resistance test to detect unhealthy conditions, and has become an important tool in preventive maintenance work. Fig. 2 shows typical time-resistance curves for an a-c armature.

6—The instrument chosen for making measurements, as well as being accurate and durable, should have a range high enough to measure the changes in insulation resistance values that occur as a result of the influence involved.

To sum up the advantages of the use of insulation resistance measurements as a means of determining the condition of electrical equipment, it may be well to emphasize the following points:

a—It provides an ideal means for supervising and controlling the cleaning and reconditioning practices of the maintenance electrician.

b—The simplicity of making the measurement constitutes one of its outstanding features. This is a strong economic factor in that it permits good control of maintenance practices without specialized supervision.

c—The practice of making insulation resistance measurements encourages "good housekeeping" and better maintenance practices. It provides a good excuse for checking conditions other than that of the insulation. Mechanical defects are noted that would otherwise be overlooked.

d—If trouble does occur, the measurement provides a quick and ready means of isolating and localizing the fault. This feature expedites and simplifies trouble shooting.

e—And finally, it provides a means for the plant engineer to obtain preventive maintenance results quickly. In other words, it helps him to reduce the size of the negative zone or valley between 0 and 20 shown in Fig. 1.

### *Current Carriers*

A good preventive maintenance technique includes among other things the consideration of the current-carrying parts of electrical apparatus. Defective joints and contacts, fractures, and improper assemblies, all contribute to the causes of service failures. The resistance of these electrical circuits serves as an excellent guide to their condition as found in service, and equally important, at the time these circuits have been reassembled after inspections of or repairs.

In the case of switchgear, experience has proven that periodic and repair check-measurements of the resistance of the interrupting circuit have paid dividends. The same can be said for main and control circuits.

In summarizing, it may be said that the success of any preventive maintenance program depends upon:

1—Economics, and the management's adherence to a program.

2—A well-trained, highly respected maintenance organization that is accepted by other departments as an important adjunct to production.

3—A recognition by all concerned of the value of "good housekeeping".

4—An ample supply of maintenance equipment, including all testing devices that are needed to determine the true condition of electrical apparatus.

5—Engineering recognition of the idea that production facilities should be chosen and installed with consideration of the maintenance problem.

ARROW AH HART

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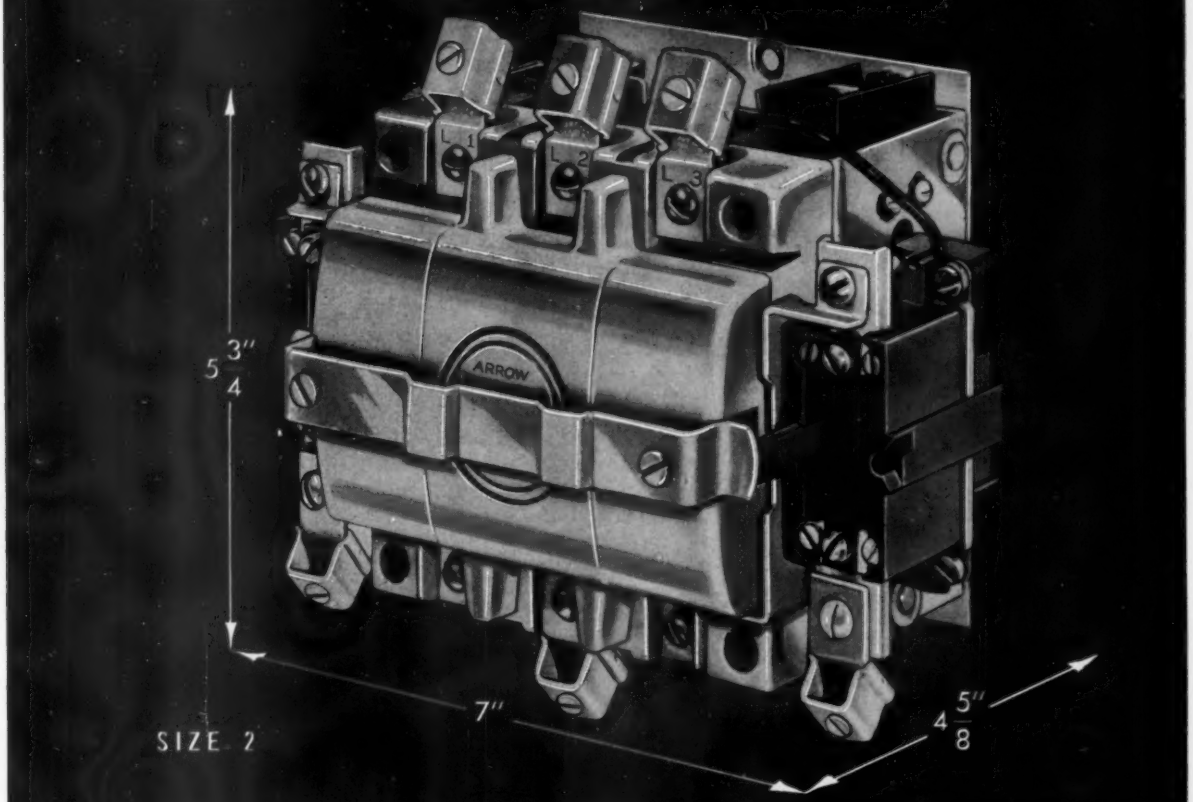


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# Power company saws through lays *Tiger Brand* Submarine

In she goes. Cable was orginally pulled across the lake with a jeep. The steel armor on cable took up the pulling strain.

Crew of men jockey the cable into position before cutting trench. Mr. Finch says, "We were amazed at the flexibility of the cable."

This is one of the two ice saws used for cutting the trench. It is gasoline powered, mounted on skids.

# 11 inches of hard ice . . . Cable without boats or barges

• The scene is Upper Saranac Lake, N. Y. Paul Smith's Electric Light & Power and Railroad Company wanted to lay a 2000-foot continuous length of Tiger Brand Submarine Cable under water. Ordinarily this would require expensive boats, barges and crews.

But Raleigh Finch, General Superintendent, decided to wait for a big freeze, saw a slot in the ice, then drop the cable to the bottom. The cable was so flexible, that it only took 15 minutes to unroll the entire 2000 feet onto the ice. The picture captions explain how the job was done.

The cable involved is 2-conductor, 5000V, #4 AWG, steel armored, rubber insulated, non-leaded. It was selected because of its flexibility, light weight and low cost. The cable joins a previous Tiger Brand Submarine Cable that was laid in 1932. According to Mr. Finch, "We haven't had a service failure in that cable since it was laid 24 years ago. In fact, we've never had a piece of Tiger Brand fail, in the 30 years that we've been using it."

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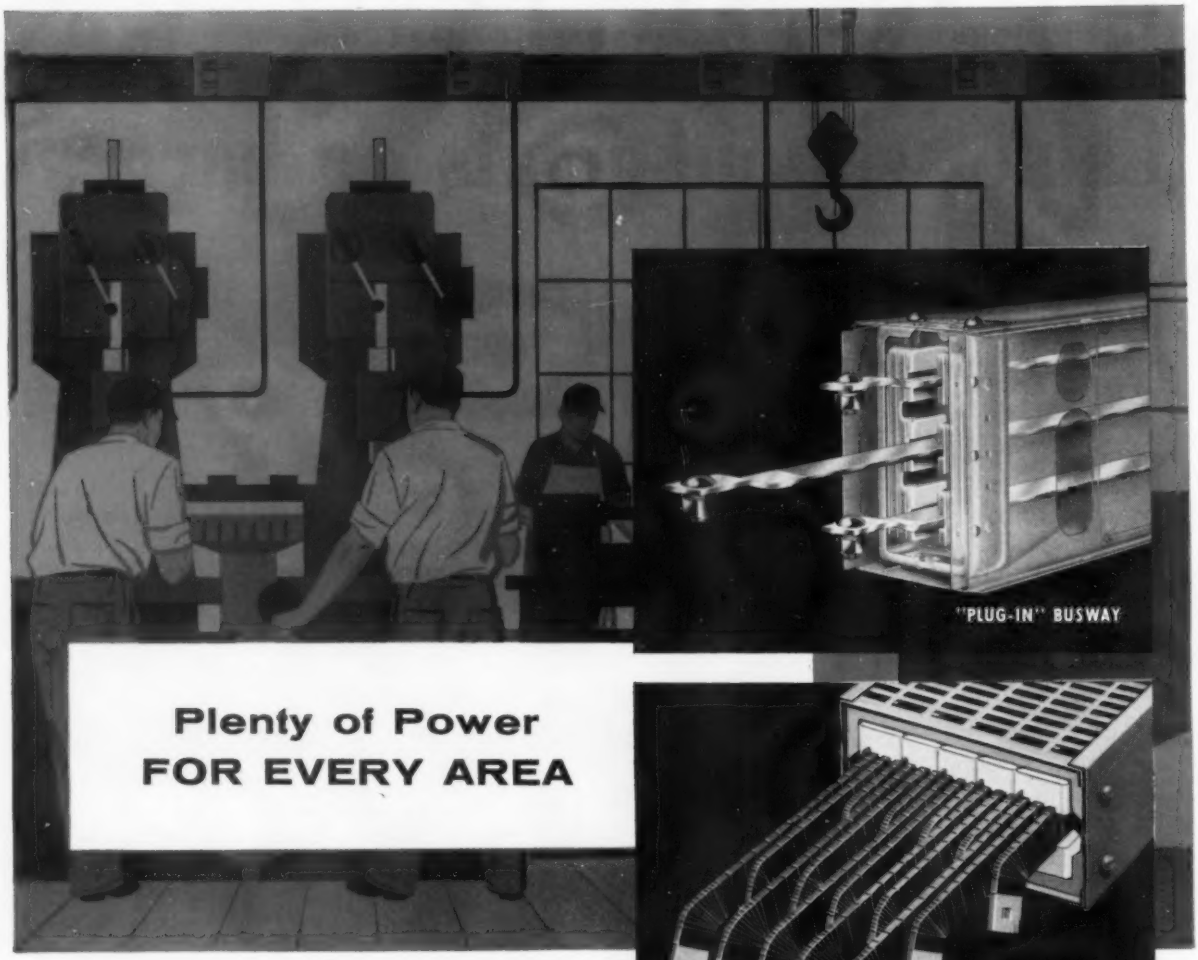


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# Practical Methods

## Special Rigs Speed Wiring in High-Bay Installation

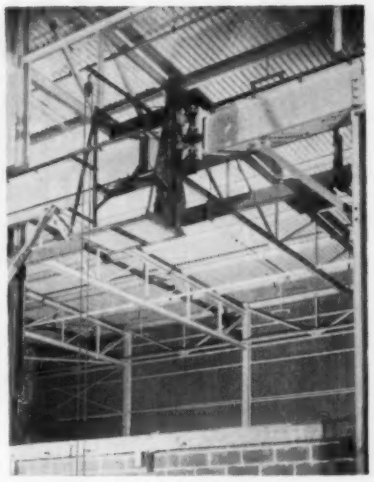
WIRING

Two special rigs, designed by the Howard P. Foley Company, saved nearly half of the estimated installation time when incandescent lighting fixtures and trolley cables were mounted in the high-bay craneways of Link-Belt's new manufacturing plant at Colmar, Pa. Since crane bays total more than a mile in length and are 60 feet wide, these rigs served a gross area of seven acres.

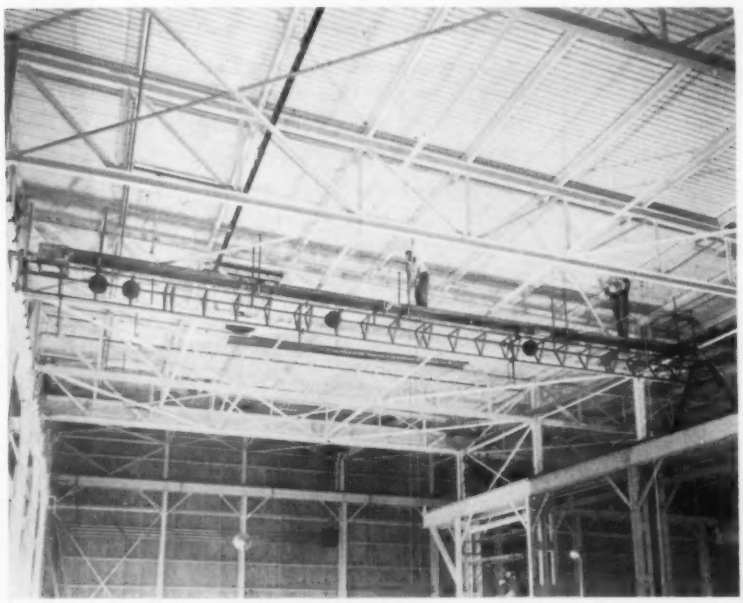
The first of the two rigs was formed from a 60-ft length of triangular television tower section. This tubular assembly served to bridge an entire bay, and it was supported at either end by a rugged A-frame constructed from channel irons welded together. The A-frames, in turn, were fitted with flanged wheels that coincided with the contour of the crane rails, so that the 60-ft wide bridge could then move freely along each bay at an elevation just below the lower flanges of roof trusses.

The television tower section was positioned so that two of the legs and their connecting braces formed a horizontal base for a ladder-and-plywood catwalk. The third leg, therefore, became in effect a common lower chord for the twin inclined supporting assemblies. Then, to further safeguard electricians working aloft, vertical stanchions were positioned at intervals along either side of the catwalk and cable lines were run between stanchion heads to serve as protective hand rails. Horizontal spindles were also positioned along the upper pipe level to support wire reels.

With this mobile working platform at the desired level, no additional scaffolding was necessary to support men installing lighting circuits and fixtures. Men could move freely back and forth along the bridge, and the bridge could be moved along the crane bay as the installation progressed. This method made it possible to install the lighting system even before the concrete floor slab of the plant had been poured. The lighting system, incidentally, consisted of 1500 fixtures, each unit containing two 750-watt incandescent lamps in standard high-bay reflectors. The rig also was used for the installation of bus duct which run laterally across the bays to supply power panels.



**HANGING PLATFORM,** supported by wheels resting on crane rails, made it possible for workers to install insulating brackets and trolley cables adjacent to web of horizontal beams. Method permitted electrical contractor Howard P. Foley Company to complete this work prior to the pouring of the plant's main floor slab.



**TRIANGULAR FRAMEWORK** of television tower section was used to support a 60-ft catwalk from which electricians could safely install lighting system and bus ducts at roof-truss level in this 300,000 sq ft industrial plant. Ends of this special bridge were supported by A-frames that rolled along crane-rails. Method reduced installation time by half.

The second special rig developed by Foley consisted of a hanging platform, likewise supported by wheels that rolled along the crane rails in the high-bay sections. This hanging platform measured approximately 2 by 4 ft in area, was equipped with a waist-high angle-iron guard rail on all sides, and also carried a small boom and pulley block to facilitate the raising of required material to the worker. The height of the working platform made it possible for electricians to install trolley cables and insulators adjacent to the vertical web of the beams beneath the crane rails and this installation was also completed prior to the pouring of the plant's main floor slab.

The Link-Belt plant at Colmar consists of a single-story straight-line manufacturing and assembly center, a 2-story office building and a modern cafeteria. The plant measures 880 feet from the receiving department at one end to the shipping department at the other, and it was engineered and erected by The Austin Company.

Factors which contributed to labor savings were: scaffold erection and relocation time avoided; interference from other trades reduced; and more efficient work on the better supports.

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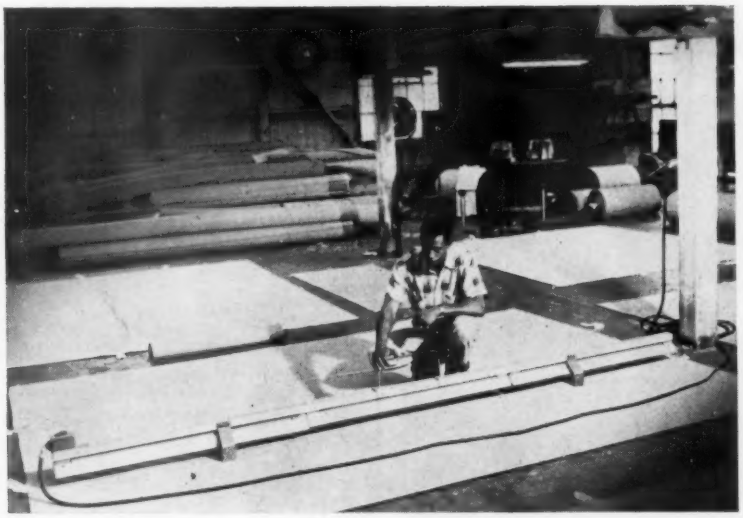

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## Electric Heat For Carpet Seams

**PROCESSING**

One of the many applications of electric heat in industry is for carpet seaming with Latex and tape. As the problem existed, it was necessary to cure Latex-impregnated binding tape on carpet seams by evaporating the solvents at carefully controlled temperature. The carpet had to be seamed quickly to a strong bond without scorching. Before electric heat was found to be an ideal solution to the problem, the curing was done by spreading the carpeting over large areas for drying overnight or even longer, depending upon weather conditions, wasting floor space.

As a solution to the problem, a portable infrared dryer was constructed using four 1250-watt Corona infrared heaters, with the patented Merco Heat Ray Tube. Construction was simplified by attaching the four 5½-in. by 48-in. heaters end to end on a light aluminum channel, making a total heated length of 16 ft. Legs were attached to keep the heaters 2 inches off the carpet. Power is supplied through a 35-ft extension cord with Twist-lock plug for connection to a 240-volt receptacle.

As it is now being done with electric heat, the tape is vulcanized to the carpet in less than three minutes, assuring a strong bond to withstand tensions applied in stretching carpeting during installations and while in service.

Selection of the Corona heater was made because the surface of the tube itself remains relatively cool as Pyrex has excellent transmission properties. This characteristic reduces fire hazards and permits location of the heater closer to the work without danger of hot-spots. Closer placement is important because infrared intensity varies as the square of the distance from the work. If distance from the work is cut in half, intensity is multiplied four times.

## Water Spray Reduces Insulator Flashover

**MAINTENANCE**

A permanent installation of spray equipment to clean insulators of outdoor substations is an asset to an industrial plant's preventive maintenance program, especially in highly dust- or soot-laden atmospheres.

The usual method, as explained by Samuel E. Kool, electrical engineer with Dorr-Oliver Inc., Stamford, Connecticut, features the use of spray nozzles installed in appropriate locations to direct a stream of water at high pressure at the insulators. The accompanying illustration shows such an installation in operation at the Sinclair Oil Company Refinery, Corpus Christi, Texas.

The danger of contaminated insulators on high voltage equipment lies in the possibility of "flashover"—a sudden and large increase in current which passes from the conductor around or over the surface of the insulator to the supporting structure. The result is damage to the conductor, insulator and support, plus tripping of the breaker and disruption of service.

While heavy rains clean the insulators to a certain extent, the effect of moisture as is imposed by fog, light mist or heavy dew is to provide a surface condition which is conducive to the adherence of dust, soot and other matter.

Every effort should be made to combat flashover through (1) proper design, application and installation, (2) reduction of contaminants in the air, and (3) improving the insulators' resistance by the application of a suitable surface coating. But, in addition, some method of insulator cleaning should be included in the plant preventive maintenance program.

Several important points should be

**SPRAY EQUIPMENT** installed at Corpus Christi Refinery of the Sinclair Oil Co is used for periodic cleaning of outdoor substation high tension insulators.

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borne in mind in applying and operating a permanent spray system: (1) The spray nozzles should always be grounded. (2) To prevent fine spray from settling on contaminated insulators (thus reducing surface resistance), washing should start from the lee side of the station, with the spray directed into the wind. (3) Insulators should be washed from the bottom up. (4) Ample water under high pressure must be used to secure instantaneous and complete flushing. (5) Spraying during the night has the advantage of giving advance warning of trouble during washing, since a condition of near-flashover is usually accompanied by an orange-colored discharge, much more visible in the darkness.

## Plug-in Parking For Milk Trucks

WIRING

A 100% refrigerated delivery system, recently introduced at the Menands, N. Y., milk plant of the Borden Company, keeps the plant's fleet of 51 delivery trucks refrigerated at a constant 40-degree temperature.

A 54,000-sq ft parking area at the plant has been equipped with 60 Crouse-Hinds DBR interlocking circuit breaker stations and plug-receptacles. Each vehicle has its own refrigeration unit and special insulation cabinet which keep dairy products cold, firm and dry throughout the delivery period. The self-contained refrigeration units eliminate the icing down of cases and resultant dripping that formerly occurred during loading conventional trucks.

At the end of a work day, the driver immediately has his truck reloaded for the next day's run, and then parks it at one of the circuit breaker stations. These are mounted conveniently on a steel rack in the center of the parking area. He removes a length of rubber-covered cable attached at

**PLUG-IN STATIONS** are mounted back-to-back on poles lined-up between truck bumpers. Weatherproof conduit arrangement is supported on poles and feeds receptacles through CB housings.

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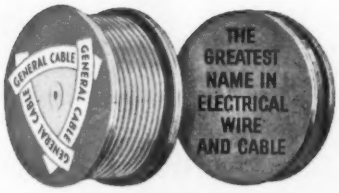


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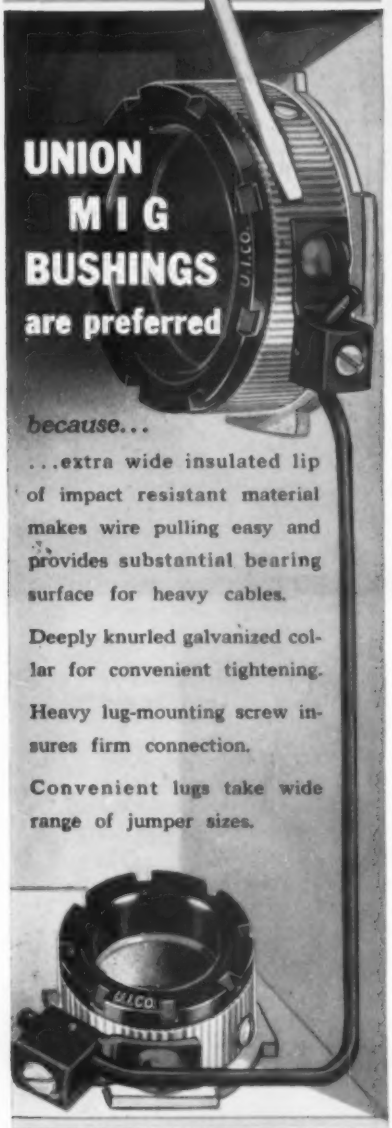
SALES OFFICES: Atlanta • Baltimore • Boston • Buffalo Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit Erie (Pa.) • Greensboro (N. C.) • Houston • Indianapolis Kansas City • Lincoln (Neb.) • Los Angeles • Memphis Milwaukee • Minneapolis • New Haven • Newark (N. J.) New York • Philadelphia • Pittsburgh • Portland (Ore.) Richmond (Va.) • Rochester (N. Y.) • Rome (N. Y.) St. Louis • San Francisco • Seattle • Springfield (Ill.) Syracuse • Tampa • Tulsa • Washington, D. C.

Where jumpers are required...




*because...*

...extra wide insulated lip of impact resistant material makes wire pulling easy and provides substantial bearing surface for heavy cables.

Deeply knurled galvanized collar for convenient tightening.

Heavy lug-mounting screw insures firm connection.

Convenient lugs take wide range of jumper sizes.




UNION INSULATING CO.
Parkersburg, West Va.

**CIRCUIT BREAKERS** are housed in dust-tight, weather-resistant boxes. Here, a driver demonstrates important safety feature: circuit breaker cannot be turned on and receptacle energized, unless plug is fully inserted. In addition, equipment has extra ground wire in cable.

one end to the van refrigeration unit and at the other to a Crouse-Hinds APJ plug. By inserting the plug into the breaker interlocked receptacle, he causes 220 volts to feed the truck refrigeration unit for the rest of the night. The next morning, after removing and replacing the plug, he drives off—in a vehicle stored with dairy products that will remain adequately chilled for the remainder of the day.

At Menands, because the trucks are parked outdoors, the circuit breakers and plug-receptacles offer several safety advantages. The circuit breakers are housed in heavy-duty feralloy boxes, which are dust-tight and weather-resistant. Although only 30 amperes are necessary at the upstate New York Borden plant, the circuit breakers can provide overcurrent protection up to a top capacity of 100 amperes at 600 volts.

Since both circuit breakers and plug-receptacles are designed for use with portable electrical equipment, they protect personnel using them in wet weather. The circuit breakers have an interlocking plug-receptacle with a spring-door housing attachment at the bottom of the breaker box. The receptacle is so interlocked with the circuit breaker that the plug cannot be inserted or withdrawn unless the breaker is off; and the breaker cannot be closed unless the plug is fully inserted. An additional safety feature is an extra contact in the receptacle and plug for connecting the grounding conductor of the portable cable.

The entire installation is designed to withstand severe climatic conditions for many years to come.


Contractors Prefer UNION

UNION INSULATING CO.
Parkersburg, West Va.

# Know more about motors...

## USE THIS HANDY APPLICATION GUIDE TO SELECT

Century

## Performance-Rated® MOTORS

### Putting Performance-Rating to work...

...is an important step in improving the performance of driven equipment. Only if the motor fits the speed, power and operating requirements of your equipment, can you be sure of top performance and trouble-free service.

Century's unusually wide range of size, speed, frame and torque characteristics makes possible countless combinations ...one of which will be precisely right for your particular application.

Choosing a Century motor, Performance-Rated to fit your job, is a matter of minutes when you use this handy Application Guide...

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- TYPE
- HORSEPOWER RANGE
- RPM RANGE
- SPEEDS — CONSTANT / MULTI-SPEED / ADJUSTABLE
- STARTING CURRENT
- STARTING TORQUE
- CHARACTER OF LOAD
- TYPICAL EQUIPM... BEST SUITED

**MECHANICA...**

- METHOD OF M... — Sleeve / Ball Bea...

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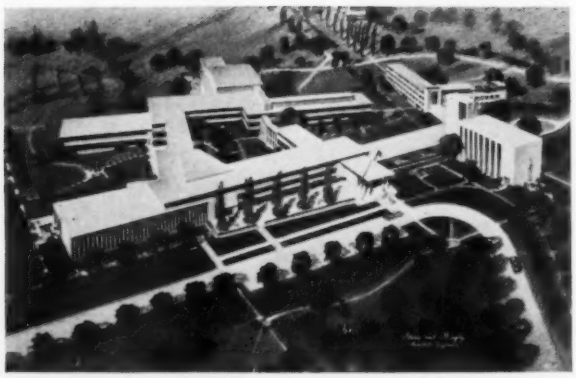
Performance-Rated®
MOTORS
1/8 to 400 H. P.

C

**CENTURY ELECTRIC COMPANY**
1806 Pine Street, St. Louis 3, Missouri
*Offices and Stock Points in Principal Cities*

Ease of installation lets you keep ahead of pouring schedules, avoid costly delays. Republic "Inch-Marked" E.M.T. is fully approved for concealed, open and concrete construction under the *National Electrical Code*. It also meets *American Standards Association* and *Federal Specifications*, and carries the inspection seal of *Underwriters' Laboratories, Inc.*



Saint Xavier College, Chicago, Illinois. Architect: Naess and Murphy, Chicago, Illinois; General Contractor: E. H. Marhoefer, Jr. Co., Chicago, Illinois; Electrical Contractor: Emerson-Comstock Co., Inc., Chicago, Illinois; Electrical Distributors: Revere Electric Supply Co., Chicago, Illinois, and Graybar Electric Co., Inc., Chicago, Illinois.

# "For Ease and Economy... We Chose Republic E.M.T."

This installation at Saint Xavier College is a clear demonstration that Republic ELECTRUNITE® E.M.T.* gives you both ease of installation *and* economy. Here's how:

*Ease of Installation.* Highly ductile ELECTRUNITE with the exclusive "Guide-Line" will keep your bends in line, every time. Troublesome "wows" are eliminated. Connections are easy, too. There are no threads to cut, no entire runs to turn. Each connector or coupling works like a union.

In concrete jobs, boxes with E.M.T. connectors attached can be spotted in advance . . . runs made with maximum ease. Add to this much easier "fishing" and wire-pulling due to Republic's inside-knurled design, and you have true ease of installation.

*Economy.* Ease of installation means dollars in your pocket, of course. And you can save even more. Exclusive "Inch-Marked®" E.M.T. lets your electricians make accurate cuts without measuring the tube itself. They simply pre-plan, measure the runs and cut at the "Inch-Marks". Then, when "Inch-Marks" and "Guide-Line" on E.M.T. are lined up with the new calibrated ELECTRUNITE bender, a perfect bend results. Waste is cut to an absolute minimum.

These advantages mean you can reduce costs and stay ahead of schedules on your wiring installation. Make sure you ask for, and get, Republic ELECTRUNITE E.M.T. Available exclusively through Electrical Distributors.

**E.M.T. is the abbreviation for the National Electrical Code description of ELECTRICAL METALLIC TUBING.*

## REPUBLIC STEEL

*World's Widest Range of Standard Steels and Steel Products*

**REPUBLIC STEEL CORPORATION**
**Steel and Tubes Division**
**212 East 131st Street**
**Cleveland 8, Ohio**

Please send me more information on Republic ELECTRUNITE E.M.T.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

K-8812

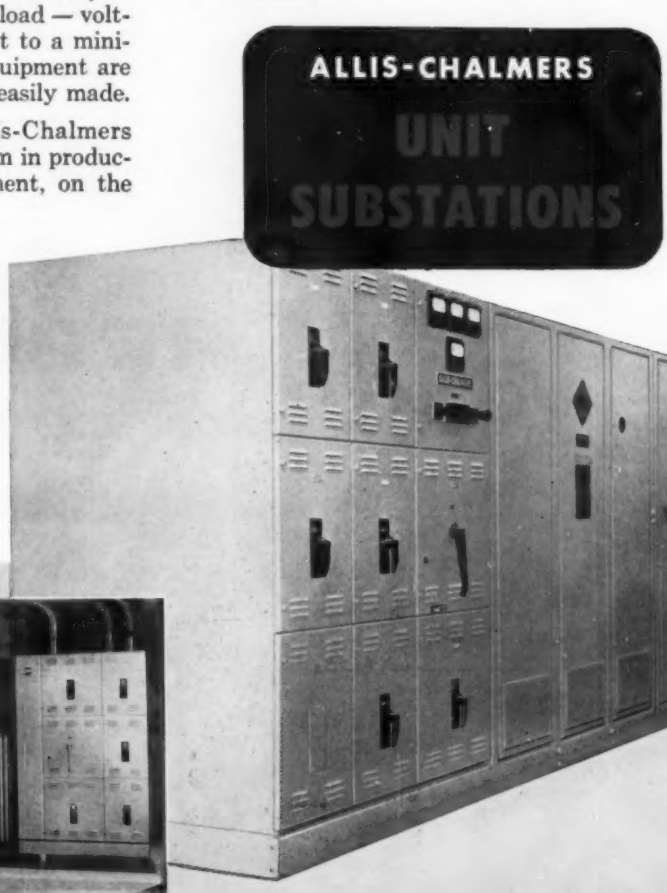
# Why You Should Modernize Electrically

VOLTAGE DROP COSTS YOU MONEY . . . in torque losses, lighting losses, and production losses. The cause is usually an outmoded or overloaded plant electrical system. Correcting low voltages is easy with Allis-Chalmers unit substations; and, in addition to eliminating these losses, you get new flexibility in plant arrangement that usually pays extra dividends.

**Get Your Full Value.** You save because *full* power is distributed from the center of load — voltage drop and conductor losses are kept to a minimum. Expensive secondary lines to equipment are kept short and flexible — changes are easily made.

**Save Space.** Compact, flexible Allis-Chalmers unit substations fit anywhere. Put them in production areas on balconies, in the basement, on the roof, or outside the building. Entirely metal-enclosed, they may be located with complete safety — no enclosures are required.

Let experienced Allis-Chalmers substation engineers help you solve distribution problems. Call your nearby Allis-Chalmers district office, or write Allis-Chalmers Mfg. Co., Milwaukee 1, Wisconsin, for your copy of "Power at Load Centers Pays Off" (11B6285B). A-4604



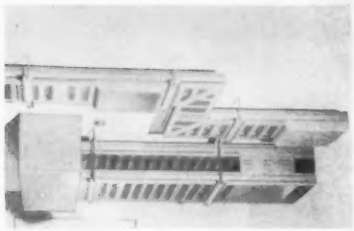

**For your unit substation**

Allis-Chalmers offers you four basic types of transformers: ventilated dry-type, *Chlorextol*-liquid filled, sealed dry-type, and oil-filled transformers. Low voltage equipment can be either manually or electrically operated air circuit breakers. High voltage switches can either be liquid filled or air break type.

*Chlorextol* is an Allis-Chalmers trademark.

**ALLIS-CHALMERS**

# Product News



## Busway (1)

A new high-reactance feeder busway design permitting interrupting capacities of more than 100,000 amps RMS symmetrical at transformer output terminals. Known as Type CL, busway is designed for use in commercial and industrial buildings for connection between service entrance and main switchboard, or wherever it is desired to reduce the available short-circuit current.

The use of Type CL busway in service entrances from secondary networks with available short-circuit currents higher than 100,000 amps RMS total asymmetrical current, makes it possible to utilize standard switchboards, panelboards, and other electrical distribution system components.

The current-limiting busway can also be used in smaller-amp-rated installations for reducing the short-circuit current between the main switchboard and motor control centers which have a maximum rating of 50,000 amps.

Busway includes taped copper bus bars, 2 in. wide, arranged in widely spaced phase groups to produce high reactance required. Special connecting straps are provided for current equalization. Unit is completely enclosed in a ventilated aluminum housing 7⅛ in. deep by 29 in. wide for all 3-phase and 3-phase, 4-wire busways in ratings from 1000 amps through 4000 amps. Single-phase, 2-wire current-limiting busway can also be furnished.

*Distribution Assemblies Department, General Electric Co., Plainville, Conn.*

## Portable Cords (2)

A complete line of portable cords for rugged applications, including a new Securityflex cord, Industrial cord and Service cord. Securityflex cord is designed for unusually severe applications, where cords are exposed to the elements and subjected to abrasion, crushing, impact, shock, moisture, oils, grease and acids. It is especially adapted to industrial applications. Industrial cord is for severe applications and resembles Securityflex in all respects, except that the neoprene jacket is cured by continuous vulcanizing. Jacket is free stripping and can be used in automatic stripping machines. Service cord is designed for hard service use—where normal mechanical damage and dampness are encountered and flexibility is needed. Typical uses are on appliances, office equipment, portable tools, and trouble lights. Securityflex cords are available in Type SO, heavy-duty 600-volt, and Type SJO, light-duty 300 volts. Industrial cords are available in Type SO and Type SJO. Service cords are available in Type S and Type SJ, stationary and constant service.

*Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y.*

## Switchgear (3)

A new line of low-voltage, metal-enclosed switchgear available in indoor and outdoor arrangements. It features new circuit breakers rated 600 amps, 25,000 aic at 600 volts (LA-25) and 1600 amps, 50,000 aic at 600 volts (LA-50). Reversible panels are mounted on each breaker compartment which permit the doors to be closed with breakers in the connected, test or disconnected position. Each breaker compartment is barriered from the bus compartments independently of the breaker frame and from adjoining breaker compartments by a double steel wall. Bus in each individual switchgear unit consists of a set of vertical risers braced with strain insulators to withstand the mechanical forces exerted by short circuit current. Main bus is supported by these risers in each unit and additional bracing is accomplished by strain insulators between phases. Bulletin 18B8283 is available.

*Allis-Chalmers Manufacturing Co., 930 S. 70th St., Milwaukee 1, Wis.*

## Electric Chimes (4)

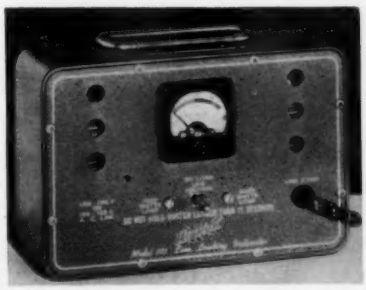
A new line of chimes features the Hideaway, a new unit only 2-in. deep for easy installation between the studs of any wall. The flush-mounted, plain face —8 by 6¾ in.—can be painted or decorated to match the surrounding wall. Other chimes in the new line cover a wide range of styles and prices, including: a unit with built-in clock; a budget model for small homes; distinguishable front and rear door signals.

*Edwards Co., Norwalk, Conn.*

## Switch (5)

A new pump control switch has been designed for applications requiring protection on loss of pressure or to initiate a cycle of operation on rising pressure. Device is capable of operation at pressures up to 80 psi. Both single and double-pole versions are available. Applications include protection of machinery against lubrication failure, as in the supply side of lubrication systems. Also, as an automatic safeguard against loss of prime for pumps in irrigation systems. A toggle and over-center arrangement insures "snap action" in the make and break of contacts. Range and differential are easily adjusted in the field. Differential can be varied from 10 to 30 psi. Literature is available.

*Square D Company, 4041 North Richards St., Milwaukee 12, Wis.*



## Instrument (6)

New line loading voltmeter, Model 101, plugs into a standard 115-volt electrical outlet and continuously reads line voltage. Built-in front panel switching arrangement permits 1000-watt or 2000-watt line load and reads resulting ac line volt change due to load. Field service and electrical unit installers use this equipment to quickly determine circuit capacity and adequacy of existing wiring to handle air conditioning units, freezers and other major appliance installations in homes or institutions.

*The Hickok Electrical Instrument Co., 10553 Dupont Ave., Cleveland 8, Ohio*

midwest MW

# PERMANENT-MOLD *Cast Connectors* FOR POSITIVE INSTALLATIONS

**APPLICATION:**

Catalog number 722V for armored cable and flexible steel conduit. Catalog number 759 for non-metallic cable.

**PRODUCT DETAIL:**

The armored cable connector embodies conventional offset chamber design; the screw has a large head for easier tightening.

The contour of the clamp on the non-metallic cable connector conforms to the curve of the body of the fitting, to insure a positive hold on the cable. The deep indentation on the clamp makes the fitting adaptable to a wide range of cable types.

Both connectors are reinforced at the cable entrance end for extra strength.

**SIZE:**

Connectors are standard trade size ⅜", for ½" threaded hub or knockout.

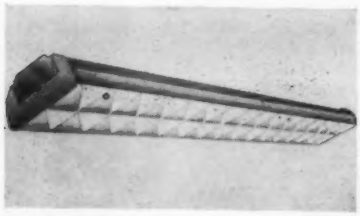
★ Here is another Midwest development in providing quality fittings. "Quality" is just a condensed way of saying: "Getting the total job done—right—with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

*Midwest Electric Mfg. Company*

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1639 W. WALNUT STREET

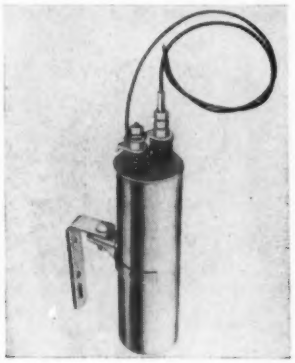
*Chicago 12, Illinois*



## School Fixture (7)

A new series of school fluorescent lighting fixtures is available with a number of lamp types: two 40-watt, low brightness, T-17, 60-in. lamps; two 40-watt, 48-in. lamps; or two 96-in., 430 ma, slimline lamps. Units may be equipped with baffles when required. High light distribution of 89% is obtained in the low brightness units, using advanced parabola design with 40° sideway angle shielding. Construction affords installation ease. Units are available in one-piece channel lengths of 4 to 10 ft, with Tong Hangers as optional accessories. Special side shields allow adjustment of upward light. Maintenance is simple, requiring no tools. Parts open and close with spring locks or pushbuttons.

*Canning-Pekara, Inc.*, 2144 *North Wood St., Chicago* 14, *Ill.*



## Capacitor (8)

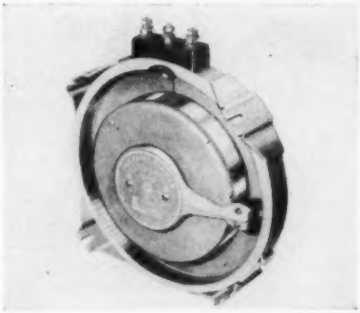
A new 7½ kvar, single-phase, 240-volt power capacitor (Type FPS) for secondary distribution circuits. Improved design provides for mounting capacitor with terminals either up or down. Also, each capacitor is supplied with a galvanized steel bracket for direct pole mounting. An adapter converts the pole bracket into a standard EEI-NEMA cross-arm bracket. Terminal-mounted fuses that are coordinated with the capacitor ratings are available. Aluminum case construction provides permanent protection against atmospheric corrosion.

*Westinghouse Electric Corp, P. O. Box* 2099, *Pittsburgh* 30, *Pa.*

## Winch Puller (9)

A new portable electric winch-puller has been designed for a wide range of applications: as a hoist, as a winch, as a cable puller, for loading and unloading trucks, for dumbwaiters, for conveyors, for moving machinery, and many other uses. The unit has a brake for stopping and holding, a clutch to afford maximum safety to persons and property, a high torque motor with reversing control and complete protection. The unit has a capacity of 500 lbs., a cable speed of 50 ft per minute and a weight of 120 pounds. Housed in a case 19-in. by 15-in. by 12-in., the winch is available for 110- or 220-volt ac, single-phase, or 220- or 440-volt ac, three-phase.

*Robot Appliances, Inc.*, 7041 *Orchard, Dearborn, Mich.*



## Dimmer (10)

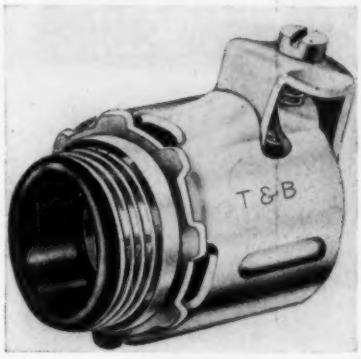
A new 6.6 kw radiastat autotransformer dimmer designed for controlling intensities of the higher capacity lighting circuits in theatres, TV studios, schools, churches, etc. Construction is of vitreous enamel. Contact segments and connections to core type autotransformer windings are completely embedded in a non-hygroscopic vitreous enamel. Features include: highest rating in smallest size, linear output voltage; stepless control, Class H insulation, sintered silver-graphite brushes, reversible rotation; can be dimmed from either end. Ratings are 10-watt to 6.6 kw, max, 120 volts, 60 cycle; continuous duty; operating torque 12 pound inches; no load loss 45 watts. Non-interlocking radiastats are available in single or multiple banks for manual operation. Interlocking types as well as remote control motor operated units also are available.

*Ward Leonard Electric Co., Mt. Vernon, N. Y.*

## Mercury Vapor (11)

A new type of garden and landscape lighting unit has been designed specifically to display foliage. A smooth shaped bullet, unit uses a mercury vapor light source to heighten color of plants and trees. The blue-green light output gives a vivid color to foliage. An ultra-violet component of the lamp output reacts with any leaves having phosphorescent pigments, causing them to glow. Unit can be used in both commercial and residential applications. The unit has 45° cutoff to prevent glare. It has a manual swivel for ready positioning.

*Lightolier*, 11 *East* 36 *Street, New York, N. Y.*




## Connectors (12)

The first line of self-insulated connectors for terminating armored cable and flexible conduit (Greenfield) has been designed for use with all conduit sizes, ⅜-in. to 3-in., both straight and 90° angle type. The insulated throat reduces wire pulling effort up to 50% and protects the wire insulation from abrasion. The ⅜-in. size (straight type) has a funnel-shaped insulating throat which also serves as a stop for the cable armor, eliminating the usual segmented metal shoulder and simplifying insertion of the conductors through the connector. The insulator in this size is made of clear plastic to permit inspection of the anti-short bushing. Insulated throat Tite-Bite fittings are of particular advantage installed in motor housings subject to continued vibration.

*The Thomas & Betts Co., Elizabeth, N. J.*

## Reflectors (13)

A new line of porcelain enameled reflectors for high bay mercury vapor or incandescent lamp mounting. Slotted-neck reflectors are especially designed for use in the illumination of high bay areas where light must be concentrated. Reflectors are finished with a white interior reflecting surface containing titanium dioxide. Lamp fittings and neck sizes accommodate 1000-watt incandescent lamps and 400-watt high or low-pressure mercury vapor lamps. A twin mounting bracket is available. For areas where excessive dust, smoke or acid fumes prevail, glass covers are available.

*Sylvania Electric Products, Inc.*, 1740 *Broadway, New York* 19, *N. Y.*

# DEPENDABLE

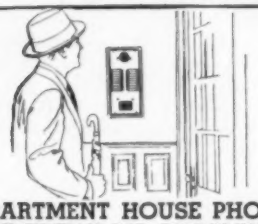
## Interior Communications & Fire Alarm Systems

NAME IT Couch MAKES IT

FOR

- HOSPITALS
- SCHOOLS
- APARTMENT HOUSES
- INDUSTRIAL PLANTS

**the complete system ● easy to install ● built for service ●**



**APARTMENT HOUSE PHONES**

PHONE SYSTEMS FOR COMMUNICATION BETWEEN APARTMENTS, ENTRANCES, SUPERINTENDENT, OFFICE, TRADE ENTRANCES, GARAGE, ETC.

Couch BULLETIN 128

**HOSPITAL SIGNALING**

VISUAL AND AUDIO-VISUAL PATIENT-NURSE CALL SYSTEMS. STAFF IN-AND-OUT REGISTERS AND PAGING SYSTEMS.

Couch BULLETIN 125

**PRIVATE TELEPHONE SYSTEMS** BULLETIN 121

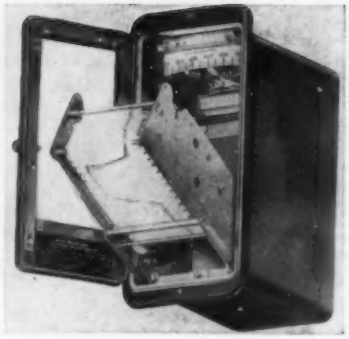
**FIRE ALARM SYSTEMS** BULLETIN 124

**DATA SHEETS AND BULLETINS AVAILABLE UPON REQUEST.**

*Built-in Dependability*

S. H. Couch Company, Inc.

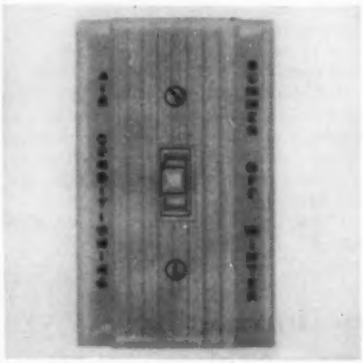
**NORTH QUINCY 71, MASSACHUSETTS**

### Recording Instruments (14)

A new line of direct-acting recording instruments is expected to simplify maintenance and operation, provide improved reliability, and permit substantial reductions in space requirements. Known as the Type 44 line, they are available as ammeters, voltmeters, wattmeters, varmeters, and frequency meters in models for portable use or for flush or projection switchboard mounting. Use of a unique self-contained forward-tilting chart drive mechanism permits adjustments and maintenance to be made entirely from front without removing instrument. Space requirements for flush mounted instruments have been reduced. Inking system includes an inkwell that can be filled without disturbing the inking pen; all moving parts, including pen, can be removed without disturbing stationary parts. When equipped with a flange for flush mounting, recorders can be mounted side by side on 7-in. centers. Net weights range from 27 pounds for the ac ammeter to 50 pounds for the polyphase varmeter.

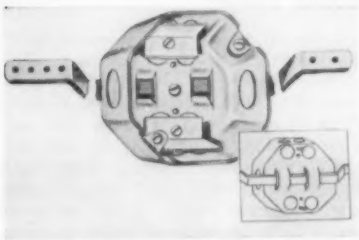
*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*



### Controls (15)

A complete line of 3-position switch controls for air conditioning units. Featuring maintained contact, switches have an "off" position in center. It is impossible to switch from one circuit to the other without first stopping at center "off" before moving switch level to second position. Available in 5-amp, 250 volts and 10-amp, 125-volt ratings, switches are offered in single pole and double pole, double throw, black or ivorylite models, and fit standard tumbler plates, or take plates indicating "Summer-off-Winter." Also available is a double pole, double throw model with 10-amp, 250 volt rating; or 20-amp, 125-volt rating. Included are lock switches for industrial installations or public building. Also available is a complete line of momentary contact switches with a center "off" position for relay control of fluorescent lighting.

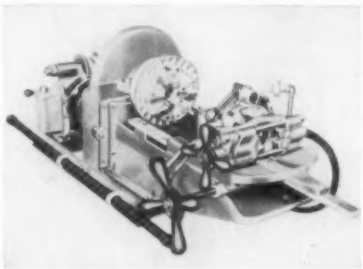
*Arrow-Hart & Hegeman Electric Co., Hartford 6, Conn.*



### Bar and Box Combination (16)

A new bar and box combination. Bar is permanently attached to the box, passing through two extruded sections in the back. This arrangement does not interfere with the amount of free space or wiring capacity within the box. When the set screw is loosened, the box can be adjusted to any position on the bar, yet will not slip off. Box is available with Romex clamps and any type bar.

*Arrolet Corporation, Montgomery, Pa.*



### Threading Machine (17)

An improved Model-A pipe and bolt threading machine in which productivity has been increased 40%. This high speed machine threads 2-in. pipe in 10 seconds; ½-in. pipe in three seconds. Machine is equipped with a power grip wrenchless chuck which further reduces the time required for chucking.

*Beaver Pipe Tools, Inc., Warren, Ohio*

### Switches (18)

A new line of miniature, Type D, 30-amp general duty switches has been designed for no-fuse, outdoor use as disconnect switches for signs, and for fusible indoor use, available with or without hubs. Units are side-operated, knife blade and single-throw. Typical applications include: commercial, industrial home and farm—signs, air conditioners, oil and gas furnaces, stokers, conveyors, flood lights, pumps, milk houses and machine tools.

*The Wadsworth Electric Mfg. Co., Covington, Ky.*

# Management called this a luxury until they tried to add a machine

This tool works *knew* about modern distribution systems and circuit breaker protection. But management was never fully convinced.

Instead, they'd settle for another line out of the old switchboard every time a new production machine was added. They did, that is, until now. For now they'd had it. They were *really* overloaded.

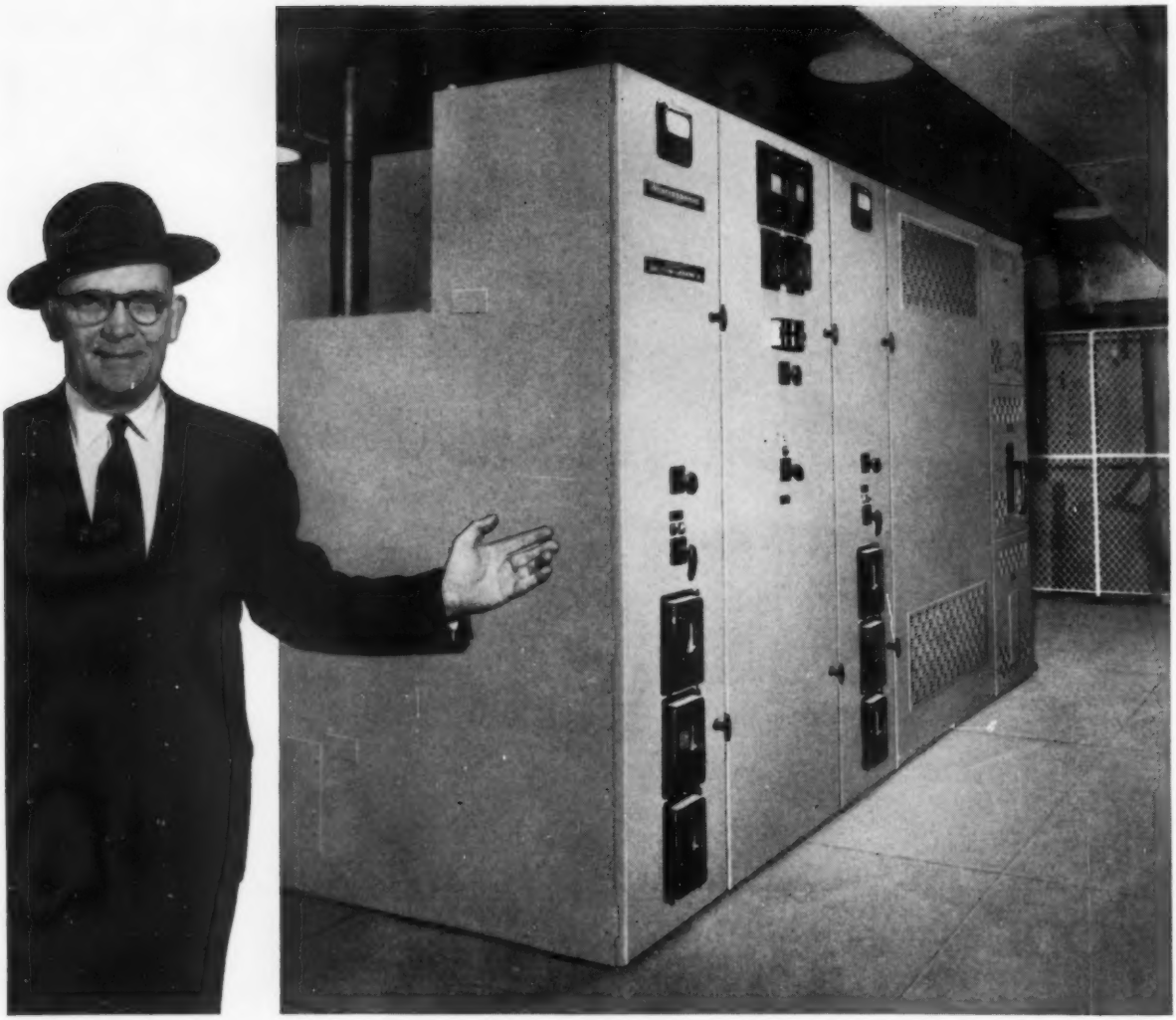
In fact, what management thought was a cost-cutting practice had mushroomed into the most expensive and dangerous heating system ever devised by man.

Either it was a matter of doing something drastic to that electrical system right now . . . or losing a lot more than the units another shaper machine could produce. DP-5011-A

**Here's the chain reaction that new machine started →**

YOU CAN BE SURE...IF IT'S

Westinghouse



# Increased load pointed up the urgency of shortening secondaries with power centers

Power centers, of course, let them carry high-voltage close to the production machines.

Results: Shorter secondaries. Less line losses and voltage drop—conditions urgently needed in this plant.

A power center, I pointed out, contains high-voltage terminals, plus a dry-type transformer and low-voltage circuit breakers. All are in a metal enclosure for safety.

There's no need for a special vault, either. So the power center was mounted over the toolroom. And the money value of the floor space saved may well offset the value of the old switchboard that was replaced. DP-5011-B

**YOU CAN BE SURE... IF IT'S**

# A need for fast machine change-overs proved the economy of plug-in bus duct

Sure. Cable and conduit *could* have been used for the new secondaries in this plant.

But the need for fast change-overs made plug-in bus duct more economical in the long run.

Westinghouse plug-in bus duct, I showed, is a power carrying method you can plug machines into whenever you wish. To change a machine—unplug it. Move down the line. Plug in again. That's all.

And installation costs are low.

Where it might take 56 man-hours to install 400-amp wire and 3-inch conduit, the same amount of 400-amp duct was hung in about 30 hours.

DP-5011-C

Westinghouse

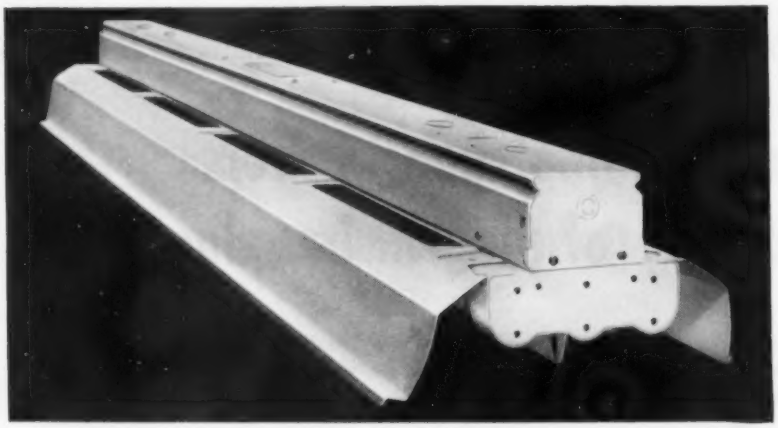
# Heavy scrap losses in poorly lit areas sold the efficiency of RLM luminaires

When people see better, they can do better. One look at the poor lighting *and* rejects here helped drive that point home.

As a necessary production tool, I recommended Westinghouse fluorescent upward component luminaires—the new trend in industrial lighting. Over 20% of the light is reflected upward. The ceiling becomes part of the lighting system, thus providing the ultimate in quality industrial lighting.

Results: Highest illumination levels with better distribution, brightness control and shielding. This makes for better working comfort and greater accuracy.

Other pluses: The lightweight, completely wired channels which permit fast installation. The heavy-duty, steel-enclosed lamp holders that eliminate breakage and make lamp replacement easy. DP-5011-D



YOU CAN BE **SURE**...IF IT'S

Westinghouse

# Why the world's HANDIEST benders also PROVE to be FASTEST!

Here's a happy electrician! His handy, portable Blackhawk Bender permits bench-top as well as floor operation . . . makes kinkless bends, matched offsets and rigid installations easy.

**FASTEST . . .**

because the Blackhawk "Porto-Power" *remotely-controlled* hydraulic jack operates in any position . . . on its side or upright . . . whichever way it's easiest to measure the bend.

**FASTEST . . .**

because it's *really* portable. You can use it on the floor, on the bench or overhead on existing pipe runs. And — it's easy to roll or carry to the job.

**FASTEST . . .**

because you can simultaneously pump and sight the job from any angle . . . assure better bends. Can be hand operated or motor driven.

**LOW COST TOO!**

Example: The S-30A kit for bending 1 to 2" rigid conduit contains powerful "Porto-Power" hydraulic jack and 9 bending attachments . . . costs only **$135.45**

*Price subject to change without notice*

**BENDERS FOR ALL WORK** — For thinwall or conduit up to 4" — Blackhawk Benders pay for themselves in a hurry. Order from leading supply houses or write for catalog 50-B. Blackhawk Mfg. Co., Dpt. P-2075, Milwaukee 1, Wisconsin.

**BLACKHAWK**

## Walk Light (19)

A new walk light for use in the home, park, industrial plant or motel. Triple-tier reflector shade is made of pressed steel with natural green porcelain exterior, black trim and white reflecting surface. Globe and reflector shade protects lamp in all kinds of weather. Cast base and metal globe adapater are finished in sprayed aluminum. Hub takes ½-in. or ¾-in. standard rigid conduit. It takes up to 100-watt lamp. Globe is available in clear glass, but can be purchased in opal, ruby, light red, amber, green, blue and orange for slight additional cost.

*Appleton Electric Company, 1701 Wellington Ave., Chicago 13, Ill.*

## Fluorescent Unit (20)

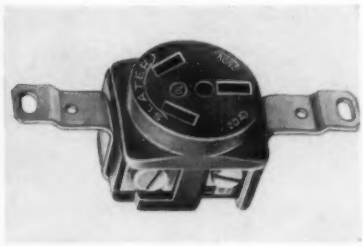
A new, flushed recessed fluorescent unit, Model 22, with dropped plexiglas for home, office and plant lighting. Units are equipped with a specially designed, removable pan, independent of housing, and containing all wiring connections. It uses two 20- or 40-watt lamps. Fixture measures 25¾ in. by 8½ in. by 4 in. Instant start is available for all units. It is UL approved. Catalog is available.

*Atlas Electric Products Co., 315 Ten Eyck St., Brooklyn 6, N. Y.*

## Time Switch (21)

A newly developed 24-hour time switch makes control of intermittent operations, including day or night shutdowns, completely automatic. It is especially adapted for marginal operation of oil well pumps and accurate cycling of processing equipment; heating, ventilating and air conditioning systems; stokers; oil and gas burners; etc. Dial of switch is scaled in 15-minute graduations which can be set for as many as 48 "on" and 48 "off" operations, automatically repeating a 24-hour schedule. Switch is available with or without a calendar device to cut out non-working days—completely selective for all seven days. Overall dimensions are 8¼ in. high, 6½ in. wide and 4½ in. deep. Rated capacity is 1000 watts. Operates on 60 cycle, ac, 110 or 240 volts. Single pole, double throw switch. It can be used or adapted for use on all types and sizes of industrial equipment.

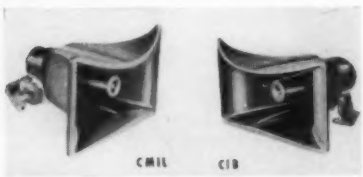
*Zenith Electric Co., 152 West Walton St., Chicago 10, Ill.*



## Receptacle (22)

A single 20-amp grounding-type receptacle, S-395, is designed for extra wiring room in the outlet box. It can be used in single-phase with a separate ground and in 3-phase wiring, or it can be used in single-phase and grounded to the yoke. Special solid phosphor-bronze contacts are used.

*Slater Electric & Mfg. Co., Inc., Woodside, L. I., N. Y.*




## Speaker (23)

A new concept in wide angle paging and talk-back speaker design has been incorporated in Models CIB and CMIL. They feature a reflexed "cobra" air column for wide angle horizontal dispersion of sound. They will function in any sort of weather or in noisy, dusty and wet locations. Model CIB comprises a built-in hermetically sealed driver unit integrally assembled to a reflex air column terminating in a cobra shaped wide angle bell. Cobra bell is a one-piece mold of fiberglas reinforced polyester resin. Driver unit employs a "rim-centered" linen-base one-piece molded phenolic diaphragm. CIB is rated at 12 watts continuous duty with a response of 300 to 13,000 cps. Horizontal dispersion of sound is 120°, vertical dispersion 60°. It measures 7⅜-in. high by 14-in. wide by 12-in. deep. Model CMIL is of similar construction except that a screw-in driver unit with ⅞-in.-18 screw thread is used. It is rated at 3 watts continuous duty with a response of from 400 to 13,000 cps. Overall dimensions are 6$\frac{3}{32}$-in. high by 9½-in. wide by 8$\frac{7}{16}$-in. deep. Brochure is available.

*University Loudspeakers, Inc., 80 South Kensico Ave., White Plains, N. Y.*

# Use Simplex Control Cables

## WITH PRINTED COLOR CODING

- Clear, white identification on a solid black background stands out every 2½ inches on two sides of each conductor in Simplex Control Cables.
- At a glance, printed color coding tells you what you want to know.
- When examining control cable conductors with colored rubber coverings in poor light, or after handling has discolored them, you know how hard it is to pick out the conductors with which you want to work.
- Printed color coding provides instant, definite identification.
- Find out more about printed color coding and the complete line of dependable Simplex Control Cables by writing to the address below.

**Simplex CONTROL CABLES**
*with* **PRINTED** COLOR CODING

**SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Massachusetts**

¼" **Heavy-Duty HOLGUN.** An extremely compact drill, designed for heavy-duty, continuous operation. Especially handy between joists.

# No matter what your need in drills—*you can't beat* BLACK & DECKER!

**For light or heavy-duty, intermittent or continuous operation, there's nothing to compare with the complete line of Black & Decker Drills. Each features a specially-built B&D universal motor, designed specifically for the drill and the job it's to do. Each is extremely compact, in comparison with the power packed inside its strong but lightweight housing.**

**¾" Heavy-Duty Drill.** Now with 40% more power than previous models for toughest applications. Timken taper-roller bearings on chuck spindle.

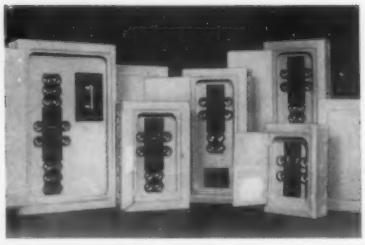
**And each features the precision parts and unexcelled workmanship that have made Black & Decker the acknowledged leader in portable electric tools. Get a demonstration of the drills you need at your B&D distributor. Or write for free catalog to: THE BLACK & DECKER MFG. CO., Dept. 2307, Towson 4, Maryland.**

**⅜" Utility Drill.** New! Perfect for light installation and repair work where heavy-duty models are not needed. Geared chuck.

**Find your nearest B&D distributor in the Yellow Pages**

Black & Decker®

**PORTABLE ELECTRIC TOOLS**

## Service Equipment (24)

A new line of fuse puller devices, designed to serve as complete, low-cost electrical distribution equipment in residential, commercial, light industrial and farm applications. Devices have as many as four fuse pullers (including main puller) and up to 20 plug fuse branch circuits. They are rated for 120/240-volt ac, single-phase, 3-wire service. All are listed by Underwriters' Laboratories. Main lug ratings of either 60 or 100 amps make the new line adaptable for nearly all service entrance applications. Devices are available with main puller for lighting and appliance circuits connected in either series or parallel with the range puller. Also included in the line are designs with either one or two extra fuse pullers in addition to the main and range pullers for separate power circuits. In these devices, one power circuit puller is independent and can be enclosed in a sealable compartment for separately metered equipment such as off-peak water heaters. All ratings are available in general purpose enclosures for both surface and flush mounting. Units with main and range fuse pullers and up to six plug fuse branch circuits can be ordered in NEMA Type 3 raintight enclosures.

*Trumbull Components Department, General Electric Co., Plainville, Conn.*

## Electric Plants (25)

New models 17A and 17D Gen-A-Matic electric plants. The 17A is an ac model with a 4-cycle engine, and weighs 95 pounds. It puts out 1.7 kilowatts offering steady power for standby use and mobile applications. A 12-volt crank winding that provides for easy installation of push-button or automatic control is standard equipment. The 17D is the dc model. Fuel capacity of both models has been increased to five quarts. Catalog is available.

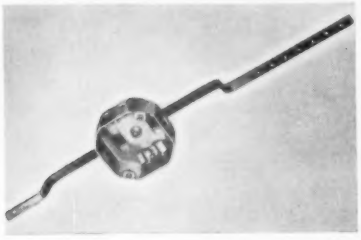
*Multi-Matic Corporation,* 14741 *Bessemer St., Van Nuys, Calif.*

## Corridor Fixture (26)

A new fluorescent lighting fixture has been designed for lighting of long, narrow areas. Ideally suited for airports, rail

and bus terminals, hospitals and schools, unit is shielded by louvers of one piece, light-weight aluminum, finished in baked white enamel. Louver arrangement is hinged for easy relamping. A special feature of the unit is the "Slideaway" lampholder which simplifies and speeds connections. 8- and 4-ft units are available, for use with either standard preheat or rapid-start lamps.

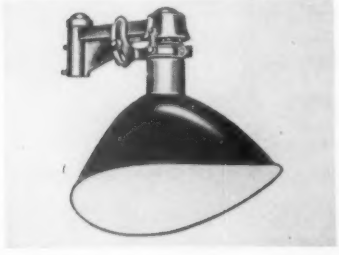
*Smithcraft Lighting Division, Chelsea 50, Mass.*



### Box and Bar Hanger (27)

New studless box and bar hangar combinations are available with 4-in. octagon boxes, 1½-in. deep, permanently mounted on either 19½-in. shallow or deep offset bar hangers. They may be furnished with "BX" clamps for installation of armored cable and flexible metallic conduit, or with Romex clamps for non-metallic sheathed cable and flexible tubing. Both types of clamps are arranged with nested fit. Bar hangers are made of ⅝-in. by ½-in. band steel with rounded mill edges. Catalog is available.

*Keystone Manufacturing Co., 23328 Sherwood, Center Line, Mich.*



### Floodlight (28)

The elliptical incandescent open floodlight fixture is designed to distribute a horizontal distribution of light for service stations, driveways, billboards, etc. Reflector is made of heavy gauge ingot iron, porcelain enameled green outside, white inside. It takes either 300-500-watt (reflector dimensions 13½-in. by 18½-in. by 18-in.) or 750-1500-watt (reflector dimensions 14-in. by 20-in. by 19-in.) lamps. Available with cast aluminum brackets, either open type for 1- to 2-in. conduit, or concealed type to slip fit over 1½-in. conduit. Two-piece, porcelain, mogul screw base sockets, medium bi-post sockets available.

*Electro Silv-A-King Corp., 1535 S. Paulina St., Chicago 8, Ill.*


*Here's why you're in luck when you install a*

# Bogen*

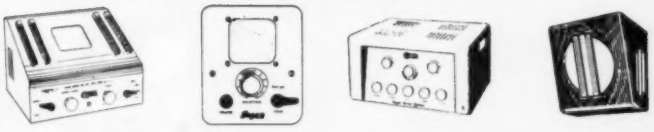
## SOUND SYSTEM

**America's Largest Manufacturer of Sound Systems*

**1. BOGEN DOESN'T MAKE YOU "DO-IT-YOURSELF".** Bogen offers you the assistance of a nationwide network of Sound experts. The Bogen Factory Representative in your territory, and your Bogen Sound Distributor will roll up their sleeves with you. Together you'll plan an installation that will give your customer all the service he needs . . . and more.

**2. BOGEN MAKES THINGS EASIER FOR THE ELECTRICIANS ON THE JOB.** From a two-office intercom to a giant rack installation Bogen Sound equipment is easy to handle on the job. Twenty-five years of designing Sound Systems have taught us how to simplify and standardize our units for easy, fool-proof installation.

**3. BOGEN EXPERIENCE IS YOUR GUARANTEE OF A TROUBLE-FREE SOUND JOB.** Bogen systems installed fifteen and twenty years ago are still performing like new. Today more schools, hospitals, factories, offices—even homes—are being outfitted with Sound equipment. Your ability to handle such jobs can be a great asset. It'll pay you to get to know Bogen Sound Systems.



Consoles Intercoms Amplifiers Speakers

**Bogen**

BECAUSE IT SOUNDS BETTER

**SOUND SYSTEMS**

*for the home, the school, the factory*

**MEET YOUR BOGEN SERVICE PEOPLE: Send this coupon today.**

If you have a Sound problem, or anticipate one, let the Bogen men in your territory show you how Bogen Sound Systems and the vast Bogen organization can help you. Mail this coupon today.

RG

DAVID BOGEN CO., INC., 29 Ninth Avenue, N.Y. 14, N.Y.

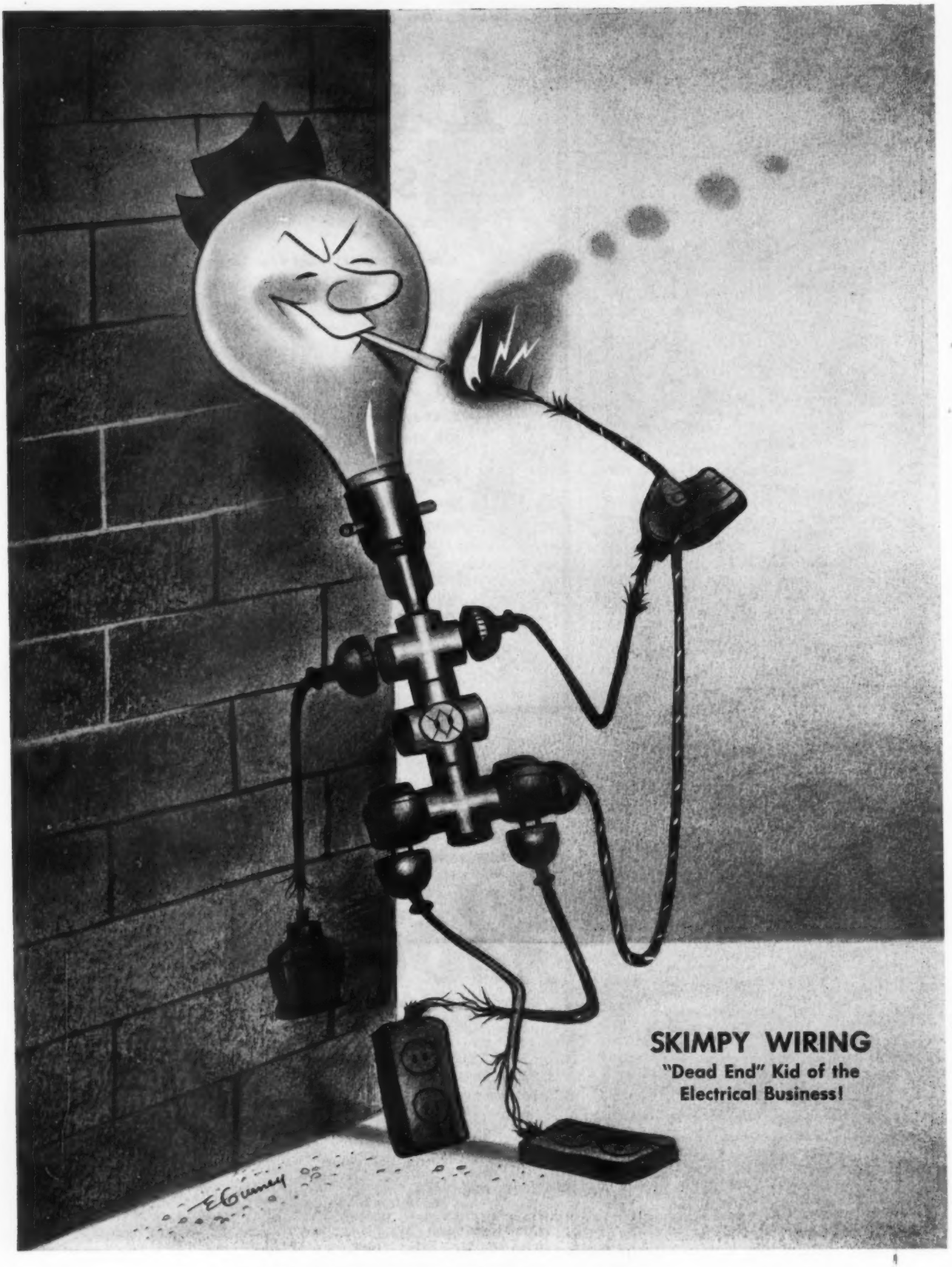
Gentlemen: I would like to have your representative tell me more about Bogen Sound Systems.

Firm Name_____

Address_____

City_____ Zone____ State_____

Ask for Mr._____ Title_____


SKIMPY WIRING
"Dead End" Kid of the
Electrical Business!

# "DEAD END" KID OF THE ELECTRICAL BUSINESS!

**But, a big profit-maker for you–that's SKIMPY WIRING!**

You know this evil little fellow. He lives in 8 out of 10 homes in America. He's the problem child of most of the electrical business, today!

But not *your* business! Because wherever you find Skimpy Wiring in a home, he means a potential *re-wiring job for you!*

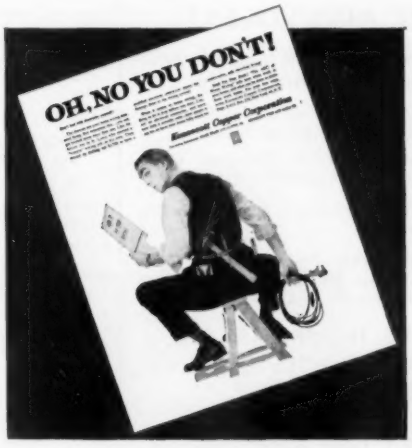
The only trouble is – most homeowners don't even know they've got Skimpy Wiring in their homes. They have to be told . . . they have to be shown how Skimpy Wiring cuts down the efficiency of their appliances, how he steals their money by wasting electricity, how he can actually set fire to their homes!

That is why Kennecott is running full-page ads like that shown below in the Saturday Evening Post and This Week magazines.

It's a campaign that adds the full power of national advertising to your own local efforts to increase your re-wiring business, to open up the way to bigger, better installations of new home wiring. Tie in with it!

## FREE! TIE-IN MATERIAL!

Add punch to your own local drive for adequate home wiring! Send today for free reprints and poster-sized blowups of Kennecott's full-page Saturday Evening Post and This Week magazine ads. Get free copies of the educational booklet, "The ABC of Home Wiring." Ask for complimentary home wiring Wall Chart, mat service folder and list of *at-cost* prices for large-quantity orders of all material available. No cost or obligation! Just write Kennecott Copper Corporation, Dept. EC75, 161 East 42nd St., New York 17, N. Y.




**Kennecott Copper Corporation**

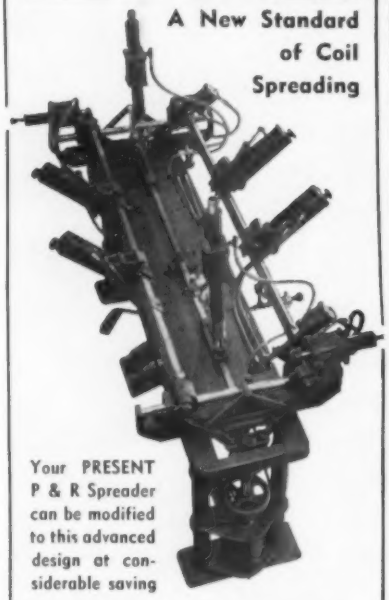
*Fabricating Subsidiaries: CHASE BRASS & COPPER CO. • KENNECOTT WIRE & CABLE CO.*

**BEGIN A NEW ERA OF PROFITABLE OPERATION WITH A**

**P&R "1500" Air Operated Spreader**

★ Packed with New Features and Advantages.
★ Greatest Coil Spreading News in 33 years.

**A New Standard of Coil Spreading**



Your PRESENT P & R Spreader can be modified to this advanced design at considerable saving

**NEW SIMPLICITY OF ADJUSTMENT**

**. . . Two nuts and a handwheel control spread and angle.**

- Unparalleled Set-up Ease and Simplicity—Greater Production Speed.
- Greater Versatility—Universal within its Increased Capacity.
- Greater Accuracy — Reduce winding Time.
- Long Trouble-Free Service — Completely Air Operated — No Complex Mechanism to Get Out of Order.

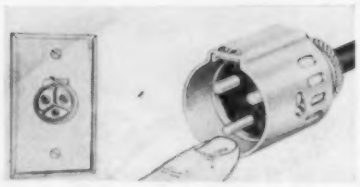
**THIS INCOMPARABLE MACHINE WILL QUICKLY PAY FOR ITSELF!**

**NOW! Get Full Details**

**CALL, WIRE OR WRITE TODAY**

POTTER & RAYFIELD, INC.
Engineering Craftsmanship

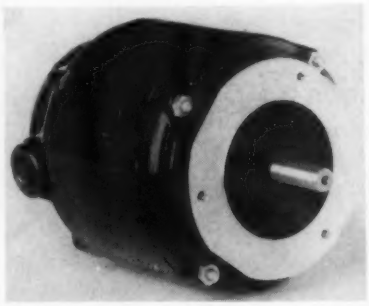
P.O. Box 1402 Atlanta, Ga.



## Plugs and Receptacles (29)

A new line of improved Midget Triploc plugs and receptacles for portable and detachable electrical devices embodying an entirely new design in contact units. Incorporated within the new interchangeable and reversible contact units are round prongs for positive contact, raised insulated arc barriers designed for increased creepage distance—two ways—between poles and to ground. Devices are designed for five different circuit needs and ten different assembly combinations. Ratings are 15 amps, 125 volts; 10 amps, 250 volts. They are self-locking, and contacts are protected by an extended housing shell.

*Pyle-National Company, 1344 N. Kostner Ave., Chicago 51, Ill.*



## Motors (30)

A new line of synchronous inductor motors featuring slow-speed synchronous operation, instantaneous acceleration and deceleration, and instantaneous reversing. Motors, designated Type SMY, are designed for applications requiring moderately high torque at low speeds, synchronous speed operation, or rapid deceleration or reversing. They are available in torque ratings of 75- and 2-ounce-inches at 60, 50, and 25 cycles. Typical installations where SMY motors would be specially useful are remote-operated beacons and searchlights, recording devices, and control and feed motors.

*General Electric Company, Schenectady 5, N. Y.*

## Switch Boxes (31)

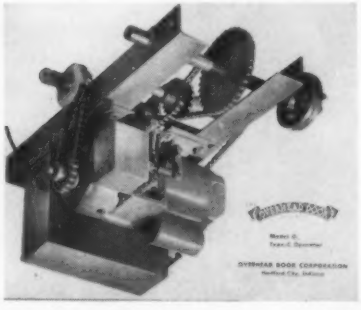
A new line of square-cornered sectional switch boxes designed to speed installation time and lower labor costs. Available in standard types, boxes feature clamps with nested fit for easy wire pulling, knockouts and pri-outs specially designed for double quick removal, and a one-screw adjustment of the channel-reinforced plaster ear which permits adjustment from 0 in. to ¾ in. In addition, boxes feature optional "leveling bumps" as well as optional mounting ears, and mounting brackets for either side or face mounting to studs. Boxes are furnished with Romex clamps for non-metallic sheathed cable, BX clamps for armored cable and flexible metallic conduit and ½-in. knockouts for rigid metallic conduit. Literature is available.

*Keystone Manufacturing Co., 23328 Sherwood Ave., Center Line, Mich.*

## Fluorescent Fixtures (32)

A new series of fluorescent fixtures, known as the Semi-Direct line, designed for use wherever seeing tasks are critical and for general illumination in industry. Available in 4- and 8-ft lengths, fixtures can be had in both rapid and instant start. Slots in unit provide a chimney effect which permits a continual flow of air. Full length grooves in fixtures permit use of slide grip hangers. Multiple knockouts provide for continuous row mounting. Flanges are included for chain suspension.

*Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.*



## Door Operators (33)

A new line of electric door operators has been developed for use with overhead, sectional, upward-acting doors for commercial and industrial buildings. Operators have their electrical controls in one easily accessible box, including reversing contactor, limit switch and transformer. To service the installed operator, a ladder can be put up in one spot and all adjustments made without moving the ladder. The use of 24-volt circuits lowers installation cost and eliminates the hazards of high voltage. There are six models in the new line, for any size of door or special installation, including heavy-duty models.

*Overhead Door Corp., Hartford City, Ind.*

# the sad case of Professor Dunkle

**OR . . . . . WHO WANTS TO REPLACE HIM?**

Dunkle taught Economics in Room 10 for twenty-six years. After five years, he had a definite squint. On his twentieth anniversary, he asked boldly for softer lights and more of them. But the school was "economizing".

Room 10 wore the air of a tomb. Dunkle's eye trouble forced him to draw the blinds against the sun, and the lights were so high up they did nothing but shine brightly at the ceiling. Students who sometimes awakened saw only spots before their eyes.

Finally, poor Dunkle had to resign, seven years before his time — a victim of poor lighting!

At the last Board meeting, everyone asked—**"WHOM** can we get to teach in Dunkle's room?"

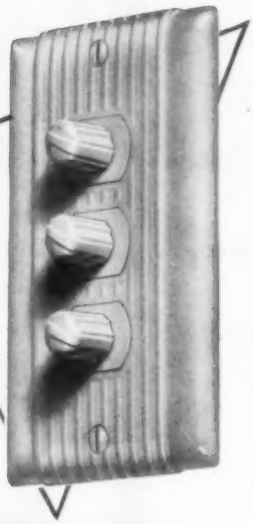
*They have since discovered the answer:* **NOBODY!**

MAKE SCHOOL DAYS **HAPPY DAYS** IN **YOUR** SCHOOL.
INSTALL SIGHT-SAVING GUTH LIGHTING NOW!
Write for name of your nearest Guth Lighting Specialist.
He'll help you work out a **plan.**

Guth
THE EDWIN F. GUTH COMPANY
ST. LOUIS 3, MO.

**TRUSTED** *name in lighting since 1902*

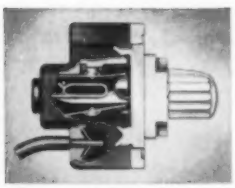
# SWITCH WITH CONFIDENCE



to the **NEW**

# ROTO-GLO®

**. . . because switches should be seen . . . NOT HEARD**



ROTO-GLO is the kind of switch you'll like to use. *You* will make a bigger profit . . . *your customers* will appreciate the extra value per dollar invested.

You will like the modern, screwless terminals that reduce labor costs, plus the fact that you can provide a modern wiring job with no changes in basic wiring habits. The totally enclosed, plastic body and non-oxidizing silver alloy contacts assure years of trouble-free performance.

*ROTO-GLO gives you something to SELL...* a switch with tremendous consumer appeal. Home owners like the quiet operation . . . the simple twist that turns lights on and off . . . the luminous knob that glows in the dark . . . the functional design that speaks for the quality of the whole wiring job.

You do your customers a service by introducing them to ROTO-GLO, and at the same time increase your own prestige by becoming identified with this new and modern development in switches.

**Available in P&S Despard type for modern, combination wiring or in conventional strap type (to fill the demand for quiet switches in the replacement market and for new work).**

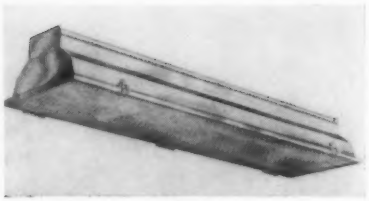
**Rating: P&S Despard type—15A, 120V AC, 277V AC**
**Strap type—15A, 120V AC**

**Write today for complete details to Dept. ECM-1**

**P&S®**

**PASS & SEYMOUR, INC.**

**Syracuse 9, New York**
**71 Murray Street, New York 7, N. Y.**
**1229 W. Washington Blvd., Chicago 7, Ill.**

## Industrial Fixture (34)

A new low brightness, industrial fluorescent fixture has been designed for even, diffused illumination in industrial precision assembly, manufacturing or inspection operations. Free from glare or "hot spot" reflections, the unit is ideally suited where polished, plated or shiny surfaces are encountered. The unit resists dirt and grime, allowing easy maintenance. It has a hinged door, available with gasket to make it splash-proof. Units are made in 4-ft lengths for two rapid-start lamps. The shielding is Albalite glass, ribbed glass or Corning Pattern No. 70.

*Smithcraft Lighting Division, Chelsea 50, Mass.*

## Outlet Box (35)

A redesigned standard 4 11/16-in. square outlet box. It is a deep drawn box, manufactured in both 1½-in. and 2⅛-in. depths. It is also available in any arrangement of knockouts up to 1¼-in. in size, and as many as 17 total knockouts on the box. The increased wiring capacities of the 4 11/16-in. square box of 30 cu. in. and 42 cu. in., makes it ideal for general installations where maximum wiring room is required. It has a hot-dipped galvanized finish. Catalog is available.

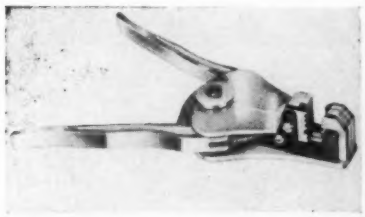
*Arrow Conduit and Fitting Corp., 129-30th St., Brooklyn 32, N. Y.*

## Cable (36)

New Cliftall UF cable for underground wiring, including direct burial, as feeders, and branch circuits, when provided with overcurrent protection. It can be used either exposed or concealed in dry, wet or corrosive areas, in masonry block, or imbedded in plaster. In Cliftall UF, bare copper conductors are insulated with thermoplastic, color coded for convenience, then covered with reinforced fiber glass. Parallel conductors are then sealed

as a unit in thermoplastic that can withstand the most rugged conditions. Approved by Underwriters Laboratories, Inc. It is available in sizes 14 to 4 AWG, single conductor only; 14 through 10 in 2-conductor with and without ground; and 14 through 10 in 3-conductor without ground.

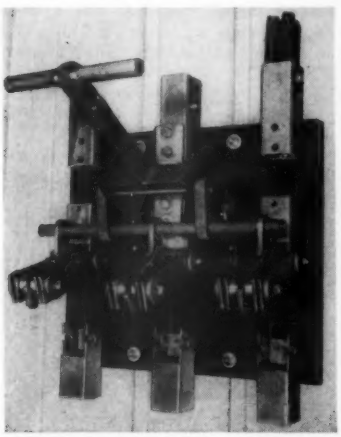
*Clifton Conduit Company, Inc., 75 Montgomery St., Jersey City 2, N. J.*



**Wire Stripper (37)**

An improved hand-type wire stripper, called "Stripmaster." It features 60% more strength through new "I" beam type handles; greater holding power in jaws; strips a wide variety of sizes and types of wire. A light squeeze of the handles strips wire clean and bare up to ⅞-in. Release handles, remove stripped wire and jaws snap back into position, ready for next cut. It is pocket size and strips both solid and stranded wire.

*Ideal Industries, Inc., Sycamore, Ill.*



**Service Entrance Switch (38)**

Stainless steel cams compress switch blades against surfaces of rectangular copper tubing in a new service entrance switch. Positive locking prevents switch from accidental opening under short circuit stresses. Switch will accommodate several types of high interrupting capacity circuit protective devices, such as the Amp-Trap, Hi-Cap or Type X fuse, without special adaptors. Features include silver-plated contact surfaces and heavy-duty solderless connectors. These are built into the tubular switch parts and compress the cables against the walls of the switch. Rated capacities of cam-lock switch are 250 and 480 volts maximum, 1200 to 6000 amp.

*Kelek Company, Norwood, Mass.*


**HUBBELL top quality WIRING DEVICES installed in new SIKORSKY AIRCRAFT PLANT**

HUBBELL

REG. U.S. PAT. OFF.

Twist-Lock®

**NO. 7310** 20 amp. 250 v. 10 amp. 600 v.

*used in production areas*

*New plant — Sikorsky Aircraft, Div. of United Aircraft Corp., Stratford, Conn.*

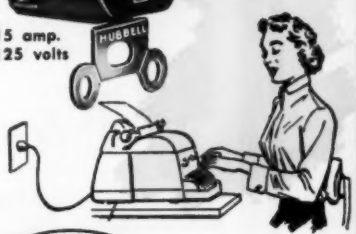
ARCHITECTS:
F. A. Fairbrother — Geo. H. Miehls, Architect and Engineer; Albert Kahn Associated Architects and Engineers, Consultants, Detroit, Michigan

ELECTRICAL CONTRACTORS
FOR MAIN PLANT:
Fischbach and Moore, Inc., New York, N. Y.
FOR MANUFACTURING FACILITIES:
Eastern Electric Construction Co., Bridgeport, Conn.

HUBBELL SUPPLIER
Sprague Electrical Supplies, Inc., Bridgeport, Conn.

Specification Grade
**NO. 5262**
Convenience Outlet
*used in office areas*

15 amp.
125 volts



***For over 20 years . . .***

**Sikorsky has used Hubbell Highest Grade Heavy Duty Wiring Devices in their factory locations. This new, ultra-modern plant at Stratford, Conn., is no exception. Hubbell devices are being installed both in factory and office areas.**

***In the Factory*** **. . . 3-wire Twist-Lock separable connectors are being installed wherever motor driven tools or portable electrical apparatus will be used.**

***In the Office*** **. . . specification grade, 3-wire, grounding-type convenience outlets will be standard equipment for electric typewriters, adding machines, and other business machines.**

**Hubbell devices are designed to meet the steadily increasing load requirements of industry. Specify Hubbell — for increasing electrical capacity . . . for safety and convenience . . . for pleasing appearance . . . and for grounding protection.**

*Highest Grade*
HEAVY DUTY
WIRING HUBBELL DEVICES

19HH55RR

FACTORY WAREHOUSE LOCATIONS ASSURE NATIONWIDE STOCK AVAILABILITY

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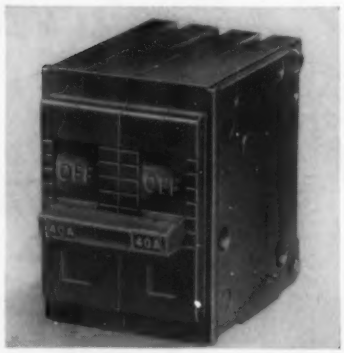
**HARVEY HUBBELL, INC.** DEPT. C-1, BRIDGEPORT, CONN.

Delivers the one complete line . . .

GUARANTEED
F
WIRING DEVICES
NO-KLIK®
QUIET SWITCHES
No. 3401 Bakelite — A.C. Only — Silver Contacts. Quiet Operation Without Mercury or Other Fluids. Not Dowd Rated. Lifetime Performance. I. Rated (T rating for A.C. Switches). Operates in any position for both Incandescent (Non-inductive) and Fluorescent (Inductive) lamp loads. Back or side wiring; strip gage. Approved for control of Fluorescent Lamps on A-C circuits of 277 Volts and less, and for motor loads up to 277 Volts at 80% of current rating of the switch. Totally enclosed mechanism with large head No. 8 binding screws. Takes any wire size up to No. 10. 15 AMPS.—120 to 277V., A-C only.
Rear View #3401 (Showing Back Wiring and Strip Gage)
No. 3421 20 AMP. SWITCH. Identified by Red Moulded Cover. Approved for control of Fluorescent Lamps on A-C circuits of 277 Volts and less and for motor loads up to 277 Volts at 80% of current rating of the switch. 20 AMPS.—120 to 277V., A-C only.
50 YEARS
CIRCLE F MFG CO.
TRENTON 4, NEW JERSEY



## Circuit Breaker (39)

A new 2-pole common trip circuit breaker, for use in panelboards and load centers, designated Type TQL. Breaker consists of 2-pole units with an interlocking trip mechanism assembled as a single unit. It will fit load centers or panelboards designed to take 1-in. Type R or Type TQL circuit breakers. Available in six ratings from 10 to 50 amps for 120/240-volt ac operation. It has an interrupting rating of 5000 amps ac. All ratings are listed by Underwriters' Laboratories, Inc. Excessive current in either pole of breaker trips both poles simultaneously. Thermal and independent magnetic trip elements provide protection against both short circuits and sustained overloads. Momentary overloads will not trip breaker.

*Trumbull Components Department, General Electric Co., Plainville, Conn.*

## Industrial Fixtures (40)

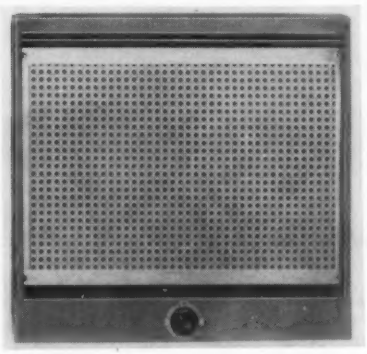
An Economy Industrial series of fluorescent lighting fixtures now includes rapid-start and 96-in. slimline units. Units feature reflectors finished in porcelain enamel for durability and lighting quality due to its permanent high reflectance factor, its diffusion for minimum glare and its ease of maintenance. Reflectors are removable without disturbing wiring. Units are available with two 40-watt, 4-ft standard starter-type or rapid-start lamps, or with two 75-watt, 8-ft slimline lamps.

*Electro Silv-A-King Corp, 1535 S. Paulina St., Chicago 8, Ill.*

## Tachometer (41)

A new model SA-6 alarm contact tachometer has been designed with an electronic control attachment which transforms the conventional tachometer in general use as a passive speed indicating instrument into a dynamic device that not only indicates speed of machines, but in addition can control machine speeds, signal and warn visually and audibly by means of signal lights, sirens or bells. It can be used to open or close valves and stop or start machinery, at any preset speed.

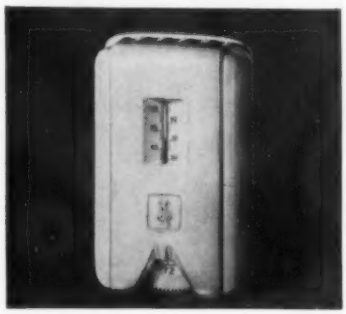
*Herman H. Sticht Co., Inc., 27 Park Place, New York, N. Y.*



## Electric Heaters (42)

A new design of ceramic radiant heaters is now available for wall-mounting and baseboard installations. In these units, the nichrone resistance wire is completely imbedded in a one piece ceramic panel. These panels are ⅝-in. thick for greater heat retention, longer and more uniform infrared radiation and greater strength. Panels are made for 115 or 230 volts, and are particularly suited to residential heating.

*Heatmore, Inc., 59 Throop Ave., Brooklyn 6, N. Y.*



## Thermostat (43)

Combination thermostat No. 801-A3 has a differential of plus-or-minus ½°F. and can be employed with all types of heating plants and air conditioning units. The unit, which is approved by Underwriters' Laboratories, has a high switch rating of 20-amp non-inductive at 250 volts ac; ¾-hp motor load at 115 volts ac; and 1½-hp motor load at 230 volts ac. It is especially designed for installation in homes, factories and commercial establishments. Unit mounts directly on a standard 2-in. by 3-in. switch box with two screws.

*Fulton Sylphon Division, Robertshaw-Fulton Controls Company, Box No. 400, Knoxville, Tenn.*

# ROEPLASTIC CONTROL CABLE

*Since Roebling pioneered this unique type of cable three years ago sales and repeat orders have skyrocketed—sure proof of outstanding merit.*

No painted conductor tracers. Conductors are *one* dark color, each with its IPCEA code color *name* and its *number* distinctly printed from end to end with indelible plastic ink which forms an integral part of the insulation and cannot be erased.

**YOU WANT**

*FREEDOM FROM ERRORS...*
*CONDUCTOR IDENTIFICATION*
*THAT IS SIMPLE AS A, B, C*
*YET ABSOLUTELY POSITIVE...*
*IN SHORT,*

**YOU WANT**

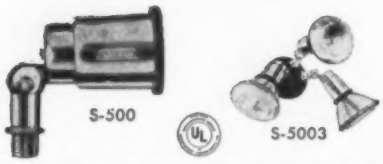
# ROEBLING

*Subsidiary of The Colorado Fuel and Iron Corporation*

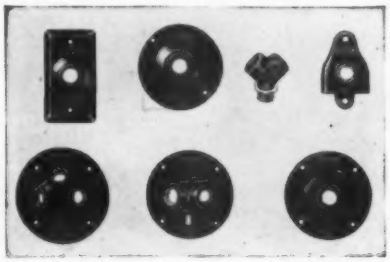
JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 3253 FREDONIA AVE. • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, TRENTON 2, N. J.

# LIGHTING AT ITS ECONOMICAL BEST...

## STEBER FLOODLIGHTS AND SEALED BEAM COMPONENTS



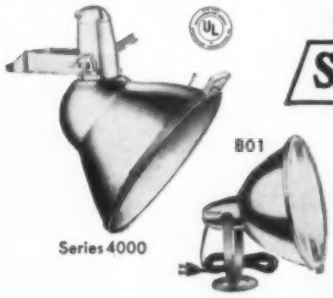

### CHROME PLATED STEBERLITES WITH FITTINGS FINISHED IN RICH BLACK!



Lustre—liveliness—sales appeal! Chrome plated Steberlites have it! The brilliant plated surface of the S-500, richly contrasted by deep black weatherproof lamp gasket and mounting flanges finished in colonial black, provides that magic touch which makes a Steberlite installation outstanding. S-500 Steberlites are fully adjustable, are factory wired and accommodate PAR-38 and R-40 medium base lamps. The mounting flanges provide for easy attachment to wall or pole, switch or outlet box—in single, two or three lamp combinations.

## STEBER VAPORTITE FIXTURES

Especially designed for both indoor and outdoor use. Heavy cast aluminum construction resists moisture, salt spray, smoke, non-explosive dust, gas and most chemical fumes. Extra thick cork gaskets provided for perfect seal between splice box and fixture and glass globe and fixture cap. Types for mounting to outlet box or to vertical or horizontal ½" conduit or pipe. Each unit can be furnished with welded wire guard to protect globe from breakage. For 100 or 200 watt lamp.




## OPEN AND ENCLOSED STEBER FLOODLIGHTS

Economical Steber floodlights are available in both open and enclosed types for lamps from 100 to 1500 watts. Each unit has ample wiring compartment (or is fully wired with cord and plug), and versatile mounting bracket for quick, easy installation. Ideal for all industrial, commercial and sports areas.

New Steber Catalog TDS-9 gives complete details. Write now.

**STEBER MANUFACTURING CO.**
**DEPT. 98, BROADVIEW (MAYWOOD P. O.) ILLINOIS**

STEBER

Steber Manufacturing Co. of California
242 So. Anderson St.
Los Angeles 33, California

Steber-Woodhouse Ltd.
2368 Dundas St. West
Toronto, Canada


### Floodlight Holder (44)

A new UL listed aluminum, all-purpose spot and floodlight holder, for supplementing holiday decorations, lighting driveways and exteriors, gardens and lawns, etc. Holder is sealed and weatherproofed by a woven asbestos gasket. Unit includes an attached 6-ft type SJO neoprene-jacketed cord with a molded-on plug. It has a dual purpose mounting plate which allows either wall or ground mounting. Holder is easily adjusted in an up and down arc so that any desired area can be spotted or flooded. Porcelain socket will accept all standard base PAR 38 flood and spotlight bulbs. Holder can also be used indoors with standard base PAR 40 heat lamps and sun lamps.

*Royal Electric Company, Inc., Pawtucket, R. I.*

### Motor Control (45)

A new Limitamp high-voltage motor control, saving over 50% in floor space. A high-voltage fused starter for coordinated control of motors up to 3000 hp on 2300- to 4800-volt systems, Limitamp control offers better protection against circuit faults up to 60,000 amps. It is designed to give maximum short-circuit protection, fuses of high interrupting capacity limit current flowing in a fault within one quarter of a cycle and interrupt within one-half cycle. Units are 30 in. deep. Being all front connected, the new enclosures can be mounted back-to-back or back-to-wall, and no back aisle is required. Suited for control of squirrel-cage, synchronous, wound-rotor, and multi-speed motors, the new starter can be mounted in a free-standing NEMA 1 enclosure, and meets NEMA Class E-2 specifications and AIEE standards. It is also available in semi-dust-tight NEMA 1A, dust-tight NEMA 5, and weather-resistant NEMA 3 enclosures.

*General Electric Co., Schenectady 5, N. Y.*

### Flexible Conduit (46)

A new liquid-tight, flexible electrical conduit called "Flex-Seal" has been designed to protect electrical wiring from oil, moisture, fumes and other conditions that deteriorate insulation. This new conduit consists of an impervious polyvinyl jacket over a flexible, galvanized steel

# split-second fastenings to steel or concrete with

# Creary Drive-It Pins

**PATENTED SELF-CENTERING PINS**

Patented ribbed guide sleeve holds Creary Pins in center of barrel for true, accurate fastening.

**HEADED PINS**

For permanent anchorage in concrete or steel.

**50 TYPES OF PINS**

There are over 50 drive pins to do your particular job. For applications where standard pins are not suited, special pins will be custom made.

**UNDERWRITER APPROVED**

Creary pins have passed all the rigid requirements of strength and pullout tests and are approved by the Underwriters' Laboratory.

**THREADED PINS**

Available threaded internally or externally for easy fastening and removal, when necessary, of anchored object.

**EYE PINS**

Use where required to suspend ductwork, ceilings and pipes.

Creary Drive-it pins give you greater penetration, greater holding power and greater operating speed. They are made of high quality alloy steel and are specially heat treated to give greatest strength and toughness. It is only because of this super strength and extreme hardness that they are able to perform the seemingly impossible . . . to penetrate up to 1" of steel for example.

Drive-it and pins have been used by leaders in the field since 1946, when the "Drive-it" revolutionized the construction industry. Today Creary pins and "Drive-its" are speeding up construction and reducing on-the-job costs throughout the world.

Be safe, be sure—use Creary Drive Pins.

Send coupon below for sample of pin and name of nearest dealer.

**Creary DRIVE-IT Pins**

LOOK FOR THE "C"
THE CREARY TRADEMARK

**SEND FOR *FREE SAMPLE***
**CREARY DRIVE PIN**

**POWDER POWER TOOL CORP.**
**7532 S. W. Macadam Ave., Portland, Oregon**

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Why

thousands upon thousands of

RIDGID

400A Power Drives are now in use

**Smart Performance**—Efficient as it looks, 400A powers your hand pipe and conduit cutters, reamers, threaders with new ease, saving valuable time. New type wrenchless Speed Chuck operates fast, grips pipe, conduit, rod tight, both forward and reverse. Quick-action centering device on rear shaft turns with pipe. Power? Plenty for pipe to 2″, even to 12″ with geared tools!

**Really Durable**—Like all RIDGID products, 400A is famous for durability. In every way, it's a lot more for your money.

**See it, try it, buy it at your Supply House!**

**The Ridge Tool Company • Elyria, Ohio, U.S.A.**

RIDGID

Work-Saver Pipe Tools

core. It bends to a very tight radius, facilitating neat work in tight quarters; and it allows the conduit to hug the contour of the machine or installation. The conduit is light in weight, requires no special tools for cutting, uses standard fittings for connections, and makes wire pulling easy. Typical applications are: food processing plants, breweries, chemical plants, machine shops, laundries.

*Columbia Cable & Electric Corp., 255 Chestnut St., Brooklyn, N. Y.*

### Extension Poles (47)

Hot-line extension poles for use with hook-on volt-ammeters provide greater safety in the use of changeable-scale, hook-on volt-ammeters on high-power transmission lines. Amertongs are available in lengths of either 4 ft or 6 ft, are 1½-in. in diameter and are equipped with an angle which permits easier scale reading. Longer extensions are available with hinges for easy transportation. They are used to best advantage where conductors are hard to reach or insulation is needed.

*General Electric Co., Schenectady 5, N. Y.*

## Product Briefs

(48) Two new models of Adjust-A-Volt variable **transformers** have been introduced by Standard Electrical Products Co., Dayton, Ohio. . . . (49) A new principle of fire detection and property protection has been announced by the Bruhn Detect-O-Stat Co., Inc., Racine, Wis. It is "Detecto-O-Stat", a **thermostatic warning device.** . . . . (50) The SAC-3 **air conditioners,** introduced by Sunwarm, Inc., Kingsport, Tenn., are for small and average-size homes.

(51) Thermador Electrical Manufacturing Co., Los Angeles, Calif., has developed a new Bilt-in **electric oven** called the "Masterpiece". . . . (52) A new **fluorescent mine light** has been announced by the American Mine Supply Co., Pittsburgh, Pa. . . . . (53) Metal-enclosed **switchgear** is now available in a uniform 3-high frame arrangement through 3000-amp air circuit breaker ratings for application at 600 volts and below. It is manufactured by I-T-E Circuit Breaker Company, Philadelphia, Pa.

(54) Arrow Fastener Company, Inc., Brooklyn, N. Y., has developed a new No. T-75 **staple gun** featuring rounded edge on staple ejection channel. . . . (55) Tennessee Stove Works, Chattanooga, Tenn., has announced a new line of **built-in-ranges.** . . . (56) Development of a new type of **silicone rubber,** capable of remaining flexible at 600 F. has been announced by General Electric Co., Pittsfield, Mass.

(57) A new series of oil-immersed, self-cooled distribution and power **transformers,** designated as type LS, has been announced by the Marcus Transformer Co., Inc., Rahway, N. J. . . . . (58) Tork Clock Company, Inc.,

Mount Vernon, N. Y., has developed a new flush **case** which keeps time switches "inside the wall". . . . . (59) A newly developed surface **cooking unit** on Admiral built-in electric range permits user to dial the exact temperature required for frying, stewing, boiling or warming foods. It is manufactured by Admiral Corporation, Chicago, Ill.

(60) Maximum protection for operators during tests of low voltage **switchgear breakers** is provided by allowing all tests procedures to be completed with compartment doors fully closed. It was developed by I-T-E Circuit Breaker Company, Philadelphia, Pa. . . . (61) "Timeter" is the name of an electrically activated **time-recording device** produced by Capeway Instrument Corp., East Bridgewater, Mass. . . . (62) A new DS-8600 Series of high speed preset **counters** is offered by Detectron Corporation, North Hollywood, Calif.

(63) Rawlplug Co., New York, N. Y., has developed **Rawl-Tapers** for fast production where anchoring into masonry with machine screws is called for. . . . . (64) A new 1½-hp 230-volt unit has been added to G-E's 1955 custom line of room **air conditioners.** General Electric Company, Louisville, Ky. . . . . (65) A 6-unit L & H Custom Bilt **cooking top** has been added to the line of electric ranges manufactured by A. J. Lindemann and Hoverson Company, Milwaukee, Wis.

(66) Now being marketed by Stanley Electric Tools, New Britain, Conn., is a new short **drill** designed to get into tight spots. . . . (67) A new protective **strain relief** spring protects electric cartridge heating units from premature lead wire breakage. Manufactured by Edwin L. Wiegand Company, Pittsburgh, Pa. . . . . (68) A flexible **cord set** for room air conditioners has been developed by General Electric Co., Bridgeport, Conn.

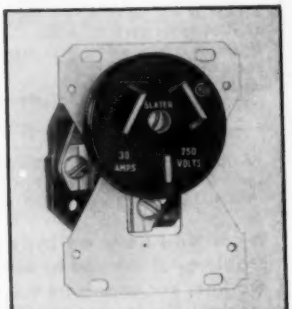
(69) Ebert Electronics Corp., Queens Village, N. Y., has announced that several improvements have been incorporated in their 2-pole, single throw EM-4 and HD-4 **mercury relays.** . . . . (70) An improved **mercury vapor lamp,** with patented electrodes which increase life and efficiency, has been announced by the Duro-Test Corporation, North Bergen, N. J. . . . . (71) Barber-Greene Company, Aurora, Ill., has announced a new Model 702, rubber tired **ditcher.**

(72) J. D. Christian Engineers, San Francisco, Calif., have designed a new line of Rite-Lo-Speed integral **gearmotors** for industrial use. . . . . (73) A new cord-end **circuit protector,** Mini-Breaker MP-452 is manufactured by Mechanical Products, Inc., Jackson, Mich. . . . . (74) Hykon Manufacturing Co., Alliance, Ohio, has announced a new **cord reel** featuring automatic cord lock and retractor.

(78) An improved one-piece, heavy-duty, double-ended **masonry anchor** for bolts is available from Rawlplug Company, New York, N. Y.


# SLATER'S NEW
## DRYER POWER OUTLET

Designed for continuous lifetime duty, Slater's rugged, new surface-type Power Outlet incorporates many new features that guarantee maximum performance. *Elevator-type terminals* ride up and down with screw. Extra room for fast wiring. Triple knockouts on back and bottom for easy mounting of cable connection. Phosphor-bronze contacts. New NEMA L-shaped slot prevents use of wrong power cap. Available for immediate shipment with black or white phenolic covers. *Order by catalog #388 or 388-W, add G if grounding strap is desired. 50-Amp. Power Outlets for ranges are also available.*



Slater's flat strap mounting type Power Outlets have **elevator-type terminals** and the new NEMA L-shaped slot. Ready for wiring, this rugged power outlet, rated 30 amperes-250 volts, is easy to install. Built for lifetime duty. Can be supplied with Cadmium or Brass plates. **Catalog #3840.**

A flush-type power outlet not shown can be mounted on a single gang box. Equipped with clamp-type pressure terminals for faster, more secure connections, this unit is extremely easy to install. It can be back wired. Uses single gang plate in Cadmium or Brass. Rated 30-Amp.-250V. *Order by Catalog #3860.*

**SEND TODAY FOR YOUR FREE COPY OF OUR NEW 4-PAGE FOLDER ON POWER OUTLETS**

SLATER
LIFETIME WIRING DEVICES
SLATER ELECTRIC & MFG. CO., INC.
WOODSIDE • NEW YORK

NEW PRODUCTS TO SAVE INSTALLATION TIME & COSTS by...

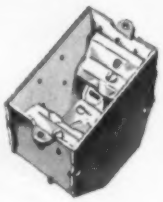
Arrolet

**Contractors Told Us What They Needed . . . We Designed these boxes . . . Now They're In Our Standard Line Doing A Terrific Job!**

**BEVEL CORNER SWITCH BOX**

**2¼"Deep, Non-Gangable**

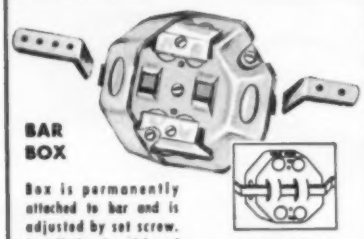
Nail-on type with notches indicating mounting depth. Available with plaster ears and various types of mounting brackets. Clamps can be mounted with screw through bevel on back.



Cat. No. 160-NG

**BAR BOX**

Box is permanently attached to bar and is adjusted by set screw. Installation is quick and easy. Available with romex clamps on any type bar.



BACK VIEW

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# Catalogs, Bulletins and Engineering Data

(79) DIMMING SYSTEM for hot cathode fluorescent lamps has a capacity of up to 160 40-watt T-12 lamps, dimming range of 750 to 1 in intensity. Bulletin 76F includes a two page data sheet giving ratings and circuits; also a two page supplement describing operational features. Ward Leonard Electric Co.

(80) MOTOR LUBRICATING DEVICES and a variety of fusing equipment are covered in illustrated 8-page Catalog 55. Trico Fuse Mfg. Co.

(81) LV CIRCUIT BREAKERS rated for 40 through 1600 amps at 600 volts include several new features such as adjustable time delay trips and indication of the faulted phase. Bulletin 18B8252, 6 pages. Allis-Chalmers Mfg. Co.

(82) BEARING EXTRACTOR for ball or roller bearings pulls from the front, does not damage bearings. 4-page bulletin on the "Tracta" illustrates components and describes functioning. Engineering Imports.

(83) FLUORESCENT BALLASTS for outdoor, non-weatherproof installations. Bulletin FL-196A, 4 pages, gives wiring diagrams, dimensions and a summary of engineering features. Sola Electric Co.

(84) SILICONE WIRE with rubber insulation has higher temperature rating which makes possible use of smaller conductors for a given load. Several types are described in 10-page Bulletin 19-594 complete with physical characteristics and comparative data. General Electric Co., Construction Materials Div.

(85) WIRING DEVICES. New 90-page Catalog 51R covers complete line of switches, receptacles, sockets and accessories. Additional 36-page supplement describes new products and also equipment listed under government specifications. Leviton Mfg. Co.

(86) ELECTRICAL TAPES for a wide range of uses are detailed in 8-page Bulletin 445; included are physical, chemical, and electrical characteristics. Bishop Manufacturing Corp.

(87) CONNECTORS for standard and special industrial applications include portable and permanently mounted receptacles and plugs having a variety of connecting and sealing methods. Bulletin B59, 12 pages, lists sets according to related wire sizes. Joy Manufacturing Co.

(88) COLD CATHODE LIGHTING techniques are illustrated in a compact 4-page bulletin covering the manufacturer's Series 12 equipment. Design and installation data is featured plus sample specifications. Cold Cathode Lighting Corp.

(89) SEALING COMPOUND for impregnating electrical insulation against premature disintegration due to moisture, extreme temperature changes and other external conditions which shorten motor life is described in a 12-page brochure entitled "The Safe-T-Seal Story". MB Aircraft Services, Safe-T-Seal Division.

(90) RECTIFIERS. Cathodic protection units of several different types are itemized in a 42-page catalog covering operating principles, dimensions, and installation data. Good-All Electric Mfg. Co.

(91) FLUORESCENT FIXTURES for commercial and industrial applications are listed in a new 28-page catalog complete with illustrations and design information. Marlou Lights, Inc.

(92) CONDUIT. A compact 24-page source of essential reference data on conduit installation, Bulletin RD-1 gives pertinent excerpts from N.E.C. and government specifications together with easy to understand discussions on each point. Weights, dimensions and spacing requirements for heavy-wall and EMT conduits are included with several other valuable tables and charts. Pittsburgh Standard Conduit Co.

(93) LIGHTING TRANSFORMERS are detailed in two bulletins giving complete electrical and physical characteristics together with description of construction features. Bulletin 551-6, 20 pages, covers mercury lamp transformers and Bulletin 551-55 describes, in 8 pages, units for use with luminous tubing. Jefferson Electric Co.

(94) SURFACE RACEWAY SYSTEM for suspending fluorescent fixtures and distribution of circuiting is described in Catalog FF-4. Components, design techniques and cost data are included. Unistruct Products Co.

(95) INCANDESCENT FIXTURE called the Paradome for pendant or ceiling mounting consists of a parabolic prismatic reflector with a concave Controlens base providing semi-direct distribution; available in 200-300-watt units. Holophane Co., Inc.

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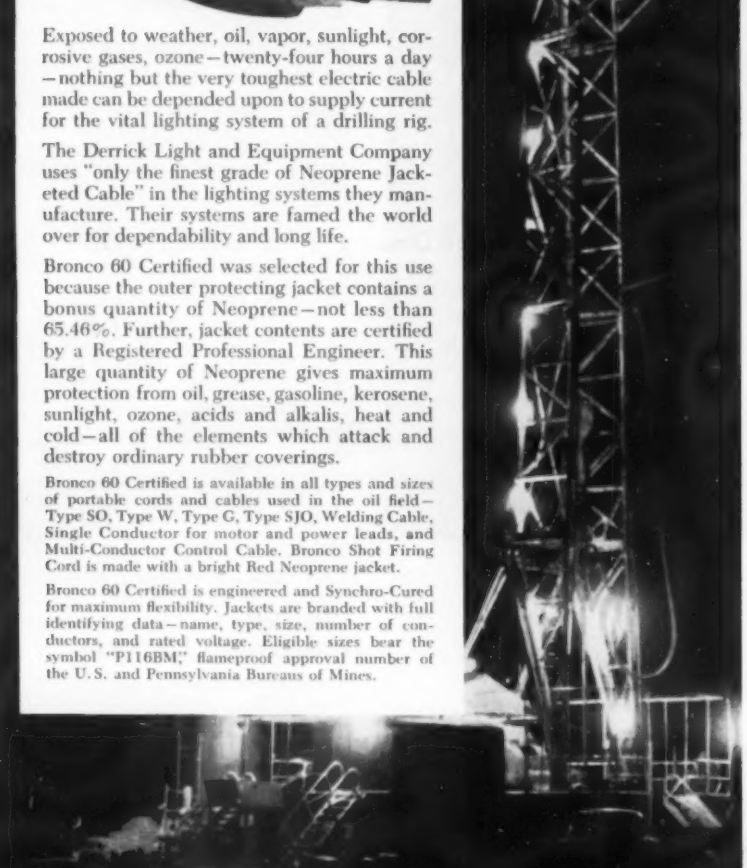

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(96) TROLLEY BUS for cranes and monorails is available in ratings from 100 to 350 amps, employs figure "8" shaped bare bar conductors which can be converted after installation to an insulated system. Catalog B8-55 gives engineering data and illustrations. Insul-8-Corp.

(97) GLASS FABRICS for electrical insulating are impregnated in a variety of finishes. 4-page folder gives sizes and electrical characteristics. Owens-Corning Fiberglas Corp.

(98) SERVICE STATION LIGHTING. Besides detailed floodlighting layouts for stations in various types of locations, this 14-page Bulletin 2677 includes information on mounting and focusing floodlights. Crouse-Hinds Co.

(99) CIRCUIT BREAKERS in ratings up to 6000 amps at 600 volts ac and 10,000 amps at 250 volts dc are listed in a new 60-page Speedfax catalog giving complete data on characteristics, accessories, dimensions and prices on all air CBs from the 50-amp "E" frame molded case units to the largest size. I-T-E Circuit Breaker Co.

(100) STREETLIGHTING with mercury lamps is discussed in Bulletin B-6513 which covers series circuits, cascade operation and auxiliary requirements. Westinghouse Electric Corp.

(101) INSULATING MATERIALS, including treated and coated fabric and paper, are the subject of a revised 20-page catalog containing technical data and applications information. Insulation Manufacturers Corp.

(102) CONTROL SWITCHES for a wide range of uses are illustrated in 48-page Catalog 5509 covering drum, foot, and limit switches: dimensions, prices and connection diagrams are given. Furnas Electric Co.

(103) MOTORS at ratings from ½- to 30-hp in single, polyphase and dc types are listed in 8-page Bulletin SDA-155 which gives specifications, selection data and information on enclosures and mounts. Peerless Electric Co.

(104) RIGID CONDUIT. Illustrated 20-page Catalog 55 describes production of Steelduct heavy and thinwall conduit, includes data tables from code. Steelduct Co.

(105) INCANDESCENT LUMINAIRES of cast aluminum for both inside and outside installations are covered in illustrated 4-page Folio 55-1. Units include wall brackets, downlights, step and night lights, and exit and directional signs. McPhilben Mfg. Co., Inc.

(106) SECONDARY DISTRIBUTION SYSTEM at the 480Y/227-volt level is described in 24-page Bulletin GEA-6223. In addition to detailing equipment and layout, the booklet shows the economics of such systems in various types of structures. Distribution Assemblies Dept., General Electric Co.

(107) BALLASTS for cold cathode lighting installations. Bulletin FL-152A presents electrical and mechanical specifications, wiring diagrams and prices on the complete line. 4 pages. Sola Electric Co.

(108) FLUORESCENT LUMINAIRES with Plexiglas diffusers are detailed in 4-page Bulletin 1173 which gives lighting characteristics, dimensions and prices. Apollo Lighting Fixture Co., Inc.

(109) TIME SWITCHES in a variety of operating characteristics are available in four different enclosures. Bulletin 155 gives details of dials and applications of each type unit. 4 pages. Tork Clock Co., Inc.

(110) BATTERIES for control, switchgear, emergency lighting and auxiliary power are described in 4-page Bulletin CP-538/55 which gives construction details and specifications of complete line. C & D Batteries Inc.

(111) SAFETY SWITCH. 4-page bulletin describes features of new type "G" switch, available in ratings from 30 to 200 amps. Murray Mfg. Corp.

(112) GARDEN LIGHTING units are equipped with aluminum spikes and weatherproof cord sets; other assemblies are designed for lighting outdoor game and social areas. Form 135-55, 8 pages. Steber Mfg. Co.

(113) RESIDENTIAL HEATING equipment covered in 12-page booklet includes pre-fabricated baseboard available in two lengths with complete line of fittings; also portable and fixed units employing ceramic cylinders with coiled nichrome resistance wiring. Cavalier Corp.

(114) LIGHTING FIXTURES for industrial and commercial applications are described in a new buyers guide covering the manufacturer's entire line of lighting equipment. Holdenline Co.

(115) POWER EQUIPMENT. Four Bulletins: 14B8231, 8 pages, covers type 257 liquid rheostats for wide-range speed control of wound rotor motor drives; totally-enclosed dry type transformers with single phase ratings to 50 kva and 3-phase ratings to 30 kva at 600 volts or below are described in 4-page folder 61B8222; indoor and outdoor low voltage switchgear features and characteristics are the subject of 4-page bulletin 18B8283; and bulletin 14B8171A includes in its 8 pages details of heavy duty dc contactors and relays. Allis-Chalmers Mfg. Co.

(116) ELECTRIC HEATING unit for the home provides additional function of air circulation. Compact equipment draws air into duct at ceiling level and passes it across heating coils then out diffuser at floor level. Entire unit is concealed in wall between studs. Electrend Products Corp.

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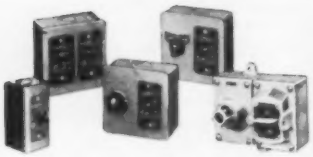
## MANUAL CONTROLS — DRUM SWITCHES — REDUCED VOLTAGE



**Bulletin 600**
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**Bulletin 350**
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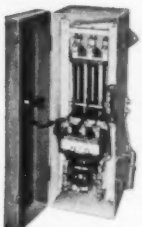
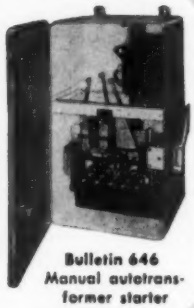
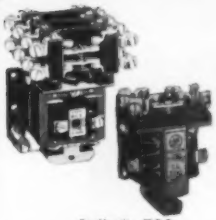


**Bulletin 640**
Manual resistance starter



**Bulletin 646**
Manual autotransformer starter

## AUTOMATIC CONTROLS — SOLENOID STARTERS — COMBINATION STARTERS



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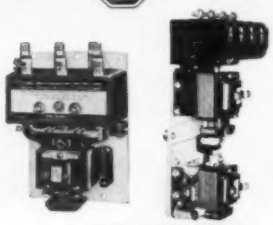
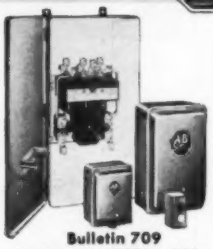
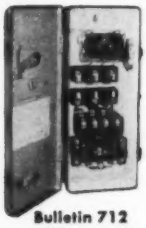


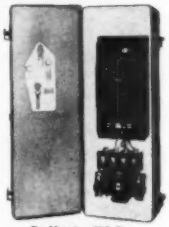
**Bulletin 702-704**
Full line of solenoid contactors in 9 sizes up to 900 amperes



**Bulletin 709**
Starters up to 300 hp, 220 v; 600 hp, 440-550 v

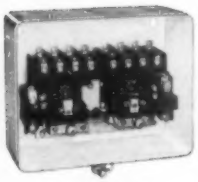


**Bulletin 712**
With manual disconnect

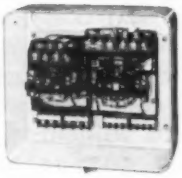


**Bulletin 713**
With circuit breaker

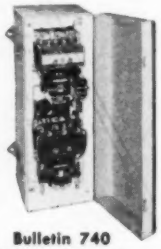
## AUTOMATIC CONTROLS — RESISTANCE STARTERS — AUTOTRANSFORMER STARTERS



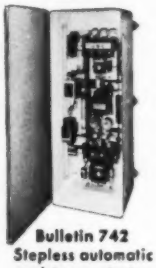
**Bulletin 705**
Reversing switch with overload relays



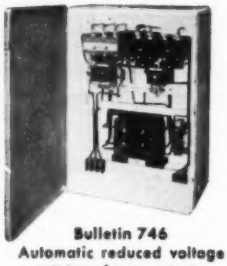
**Bulletin 715**
Multi-speed starters for 2, 3, & 4 speeds



**Bulletin 740**
2-Step automatic resistance starter



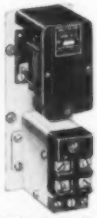
**Bulletin 742**
Stepless automatic resistance starter



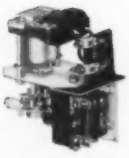
**Bulletin 746**
Automatic reduced voltage autotransformer starter

## ACCESSORIES — LIMIT SWITCHES — PUSH BUTTONS

**Bulletin 848**
Dashpot timer



**Bulletin 849**
Pneumatic timer



**Bulletin 850**
Motor-driven timer

**Bulletin 802**
Limit switch

**Bulletin 802T**
Oiltight limit switches

**Bulletin 800-800T Push Buttons**
Hundreds of standard, heavy duty, and oiltight push buttons, and pilot lights

For complete information on the Allen-Bradley line, please write for the A-B 120-page Handy Catalog.

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# Reader's Quiz

**QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.**

## Fluctuating Load and Light Flicker

*QUESTION F28—Is it possible that a fluctuating load on a 20-hp air compressor would cause lights to flicker? The compressor is part of a load at a station fed by two 25-kva transformers. High lines are No. 2 copper. The light flicker takes place at other stations fed by 5-kva and smaller transformers. The high line is 4265 volts. —E.S.H.*

ANSWER TO F28—The full load capacity of two 25-kva transformers in open delta, as these are, is 86% of 50 kw or 43 kw. So these transformers are only about half loaded by the compressor. Normally, this small reciprocating load should not cause light flicker. However, the fact that No. 2 copper is used for this 4265 volt line indicates to me that this station must be remotely located from its substation. In this case, a small load could possibly cause this flicker to be reflected back into the primary line, especially if the total load is of low power factor. Capacitors might help this condition considerably.—E.A.M.

ANSWER TO F28—It is possible for a load as described to cause "lights to flicker." This is particularly true if the compressor is not in satisfactory operating adjustment as to its valves and load-control devices usually for the loading and unloading features. It is not stated whether the equipment is in one assembled unit or is belted. If the compressor has a flywheel not suitable for its operation this is a common reason for the unsteady action. In the absence of details, servicing by the compressor manufacturer seems in order as an indicated approach.—C.O.D.

## Electrode Burning In Arc-Furnace

*QUESTION G28—One of the 3-phase electric arc furnaces we service has been burning one of the carbon electrode ends at about 45-degree angle facing the shell of the furnace and causing rapid deterioration of the lining in that area. The other two electrodes burn off nearly flat as they should. The spacing of the electrodes is equal, and the voltage on each phase is the same; 180 volts on the low tap and 235 volts on high tap. What could be the cause of this condition?—J.J.L.*

ANSWER TO G28—Under normal conditions a 3-phase arc will form a neutral point at some point approximately equidistant from the three electrodes, assuming balanced voltage and no accidental grounds on the transformer. The trouble J.J.L. is having is probably caused by one phase of his power supply becoming accidentally grounded. This would cause the neutral of the arc to shift toward the grounded phase. If this ground is cleared up, I believe normal operation can be expected.—E.A.M.

ANSWER TO G28—The condition of angle-burning of electrodes can be attributed to poor location of the electric arc furnace in that there is no free circulation of air about the furnace whereby poor dissipation of heat would result. Other factors such as excessive crowding of stored materials, dirt and dust around this particular section of the furnace can contribute to this condition.

On the other hand, the spacing of the electrodes may be equal but the one electrode may tilt or work toward the shell of the furnace when nearing the metal, or the arc produced for melting may be working the electrode toward the shell especially if there is poor circulation of air.

If a winch system of raising and lowering electrodes is used, there is a possibility of tilting the one electrode because of its delta or triangular spacing, by putting more stress on this one particular electrode.—J.B.K.

## Operation of Rapid-Start Lamp

*QUESTION H28—How does a rapid start fluorescent lamp operate and how does the ballast and lamp differ from the regular preheat type?—D.H.N.*

ANSWER TO H28—The rapid-start fluorescent lamp has bi-pin bases at its ends like the standard preheat lamp, and has coated cathodes at each end. These cathodes are triple-coiled and heavily coated for long life. Use of the rapid-start lamp requires a special rapid-start ballast, but no starter is used. The ballast has special low-voltage windings which supply current to the cathodes in the lamp. The cathodes, because of their construction, heat up rapidly and allow striking of the arc through the mercury in the tube. Once started, the rapid-start lamp operates the same as the standard preheat lamp, but the cathode heating circuits are not opened as in the case of preheat lamps using starters. Rapid-start lamps start without blinking, a second's delay after the switch is thrown. They have a life of about 7500 hours when operated three hours per start. Other types of fluorescent lamps—standard preheat and instant-start slimlines—should not be used on the rapid-start ballast. Care should be taken to distinguish rapid-start lamps from standard preheat lamps and instant-start lamps. Rapid-start lamps *are not* instant-start lamps; they *are not* standard preheat lamps. Their method of starting is distinctly different from that used in instant-start and preheat lamps.—F.X.M.

ANSWER TO H28: The rapid-start fluorescent lamp operates in much the same manner as the preheat type, once the lamp is started. Briefly, an electric arc is initiated between the ends of the tube. The electrons in this arc impinge on mercury atoms within the tube producting ultra-violet radiation. This radiation in turn excites the phosphor lining of the lamp to produce visible light.

In order to establish the arc within the lamp, electrons must be obtained from the electrodes at the ends of the tube. The preheat lamp has coated cathode electrodes, similar to those in an electronic tube, that gives off electrons when heated. This supply of electrons is then propelled down the tube by a relatively low voltage gradient (Approximately 200 volts).

Instant-start lamps use a much higher voltage (450 to 750 volts) which is capable of drawing the necessary electrons from the cathodes without preheating. The ballast for an instant-start lamp differs from a preheat ballast in being able to produce the higher terminal voltage which is required to start the lamp. This results in a larger physical ballast size and greater ballast losses.

As in the case of preheat lamps, the ballast also serves as a choke to limit the current once the arc has been established.—L.D.B.

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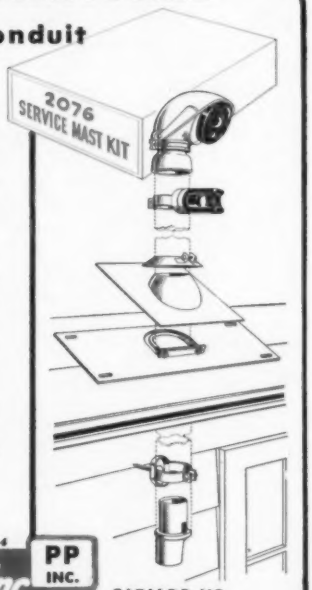


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**QUESTION S28**—Please explain the operation and type of a motor having nameplate data of 115 volt, 1 phase, 13 amps and six brush holders. The motor has forward and reverse directions—J.B.K.

**QUESTION T28**—Having installed a number of transformer vaults with oil filled transformers and associated secondary switchgear and also load centers with dry type transformers, I would like to know what is the deciding factor in the use of either.

A hypothetical case I have in mind is a school with a 300-kw load. In this case what determines whether a transformer vault should be built and oil type transformers used or whether a load center with dry type transformers without a transformer vault should be used. Also interested in what is the determining factor for other loads.—F.D.

**QUESTION U28**—What are the minimum requirements for a disconnecting means ahead of a capacitor bank size 120 kvar, 3-phase, 60-cycle, 460 volts. This capacitor is to be used at the end of a 500 MCM line, which is fed from a circuit breaker rated 600 amp continuous and 25,000 amp for one second. Type A-K-1-25.

Is a 400-amp safety switch with fusetron fuses suitable? Is a 225-amp I.T.E. breaker No. E.T.-7045-B suitable?—M.D.

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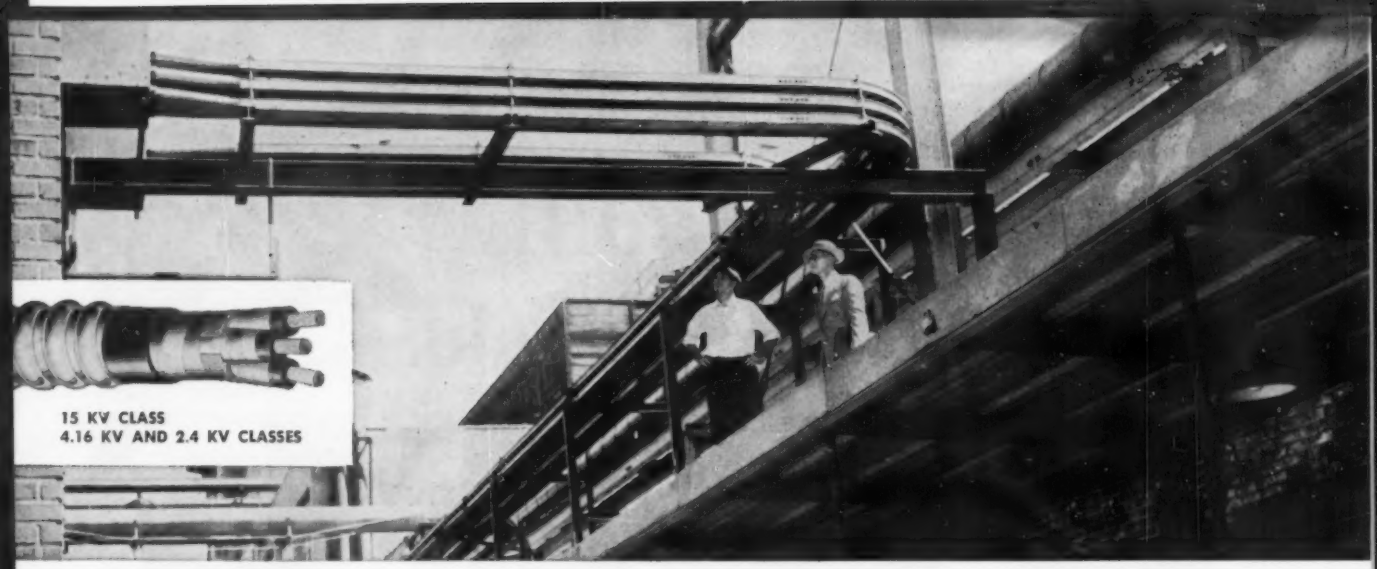

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4.16 KV AND 2.4 KV CLASSES

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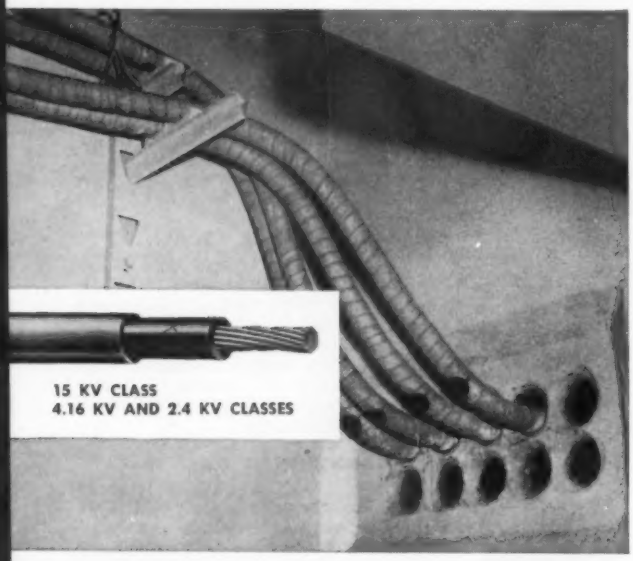

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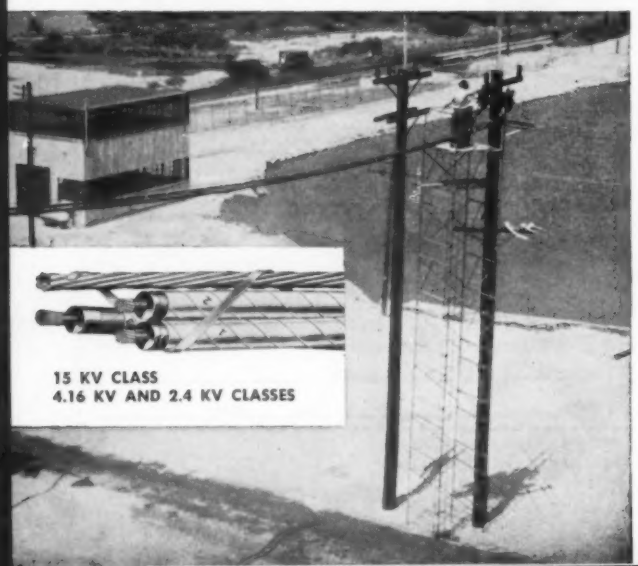

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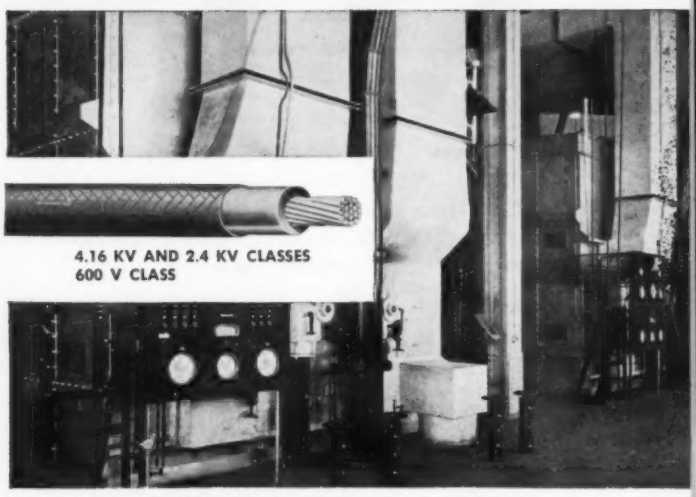

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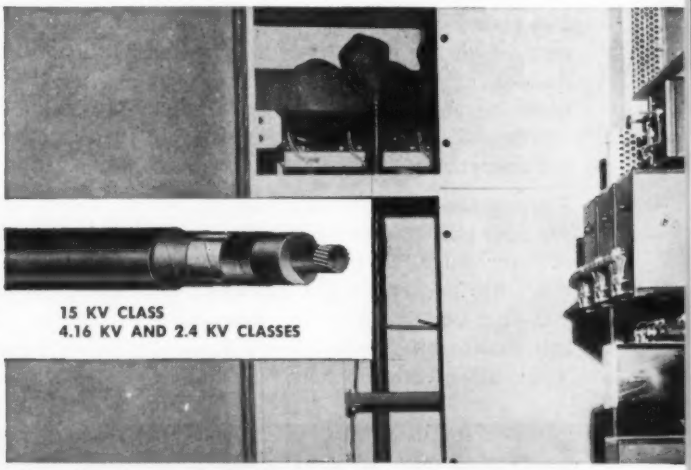

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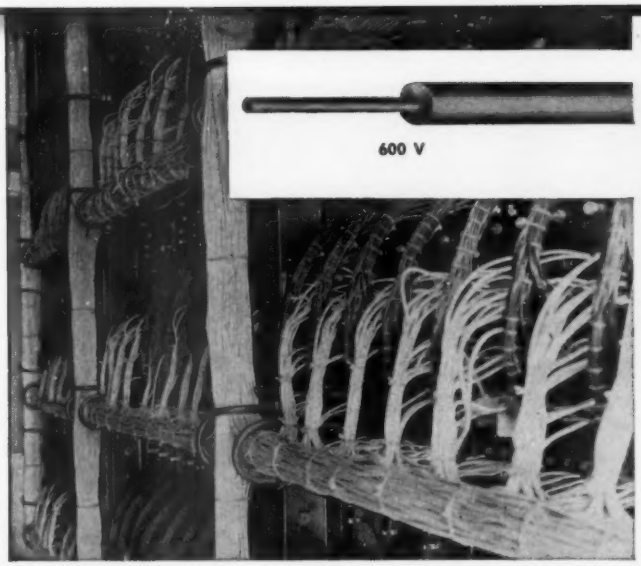


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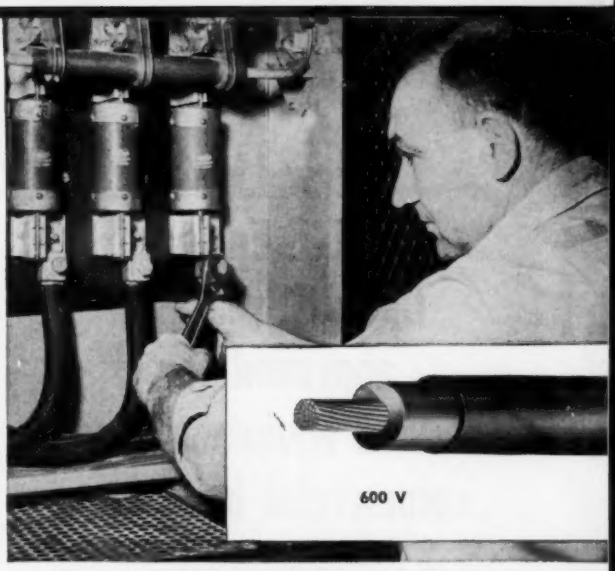


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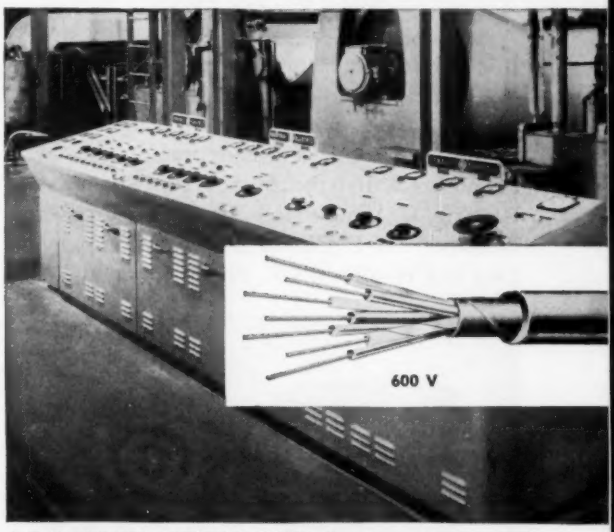


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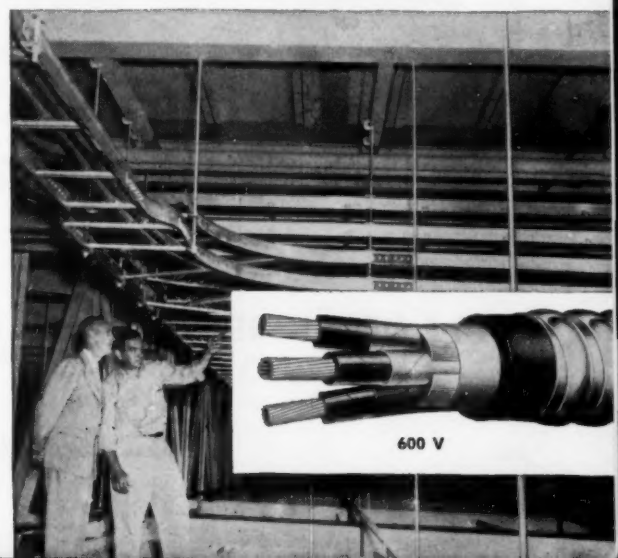

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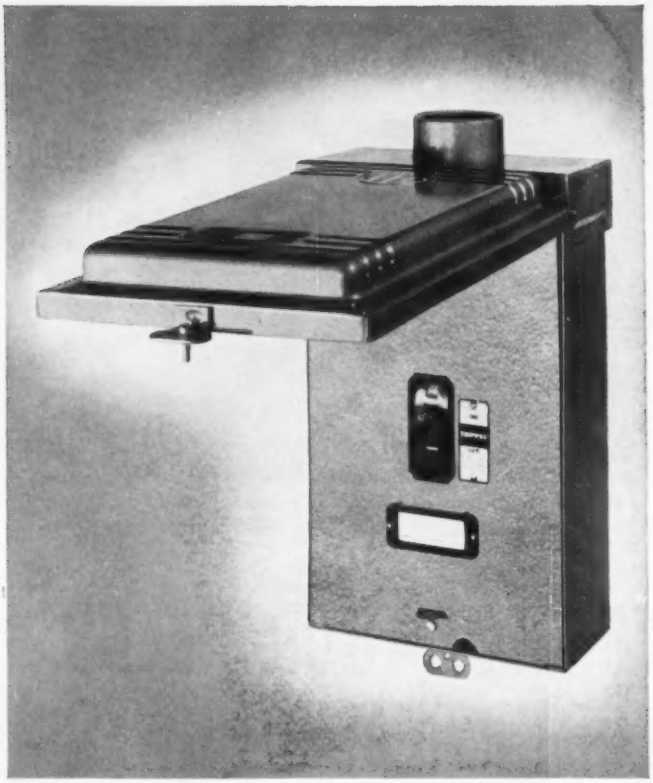
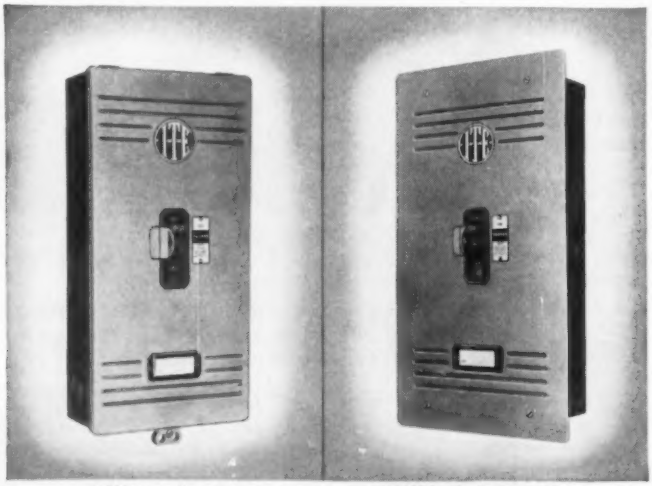


**NEMA 3** has automatic cover latch which retains cover in fully open position, is equipped with inner dead front sheet which isolates breaker and wiring.



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# Questions on the Code

*Answered by*

**B. A. McDONALD,** *New York Board of Fire Underwriters, Rochester, N. Y.*
**GLENN ROWELL,** *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
**B. Z. SEGALL,** *Consulting Electrical Engineer, New Orleans, La.*

## Gasoline Pumps and Seals

**Q.** *In Section 5120 sub paragraph f. 1: "An approved seal shall be provided in each conduit run entering a dispensing pump or other equipment on a dispensing island. There shall be no union, coupling, box or fitting in the conduit between the sealing fitting and the point at which the conduit enters the pump or other equipment".*

*My question is where shall the seal fitting be located on drawing sent in with this question.*

*Regarding f. 2 additional seals, I have four pumps in an old station to hook up. Without tearing up the drive to get lines under it we are going to come down the cement columns at the end and center of pump island then down the side and under the island in a ditch, come up under the island in the pump center. The line will come down the column from the top about 24 inches from each pump as indicated in my drawing. Where shall I put seal fitting on the line that comes down the column?*

*If the line runs underground to the inside of the station, or to the office, a storage room, where the panel is located, where shall the seal fittings be placed?*

*Would it be proper to place them 18 inches above the floor where they come through if they are accessible? If the panel is recessed to flush with wall, is there any way to seal off lines in a case like this?*—K.C.

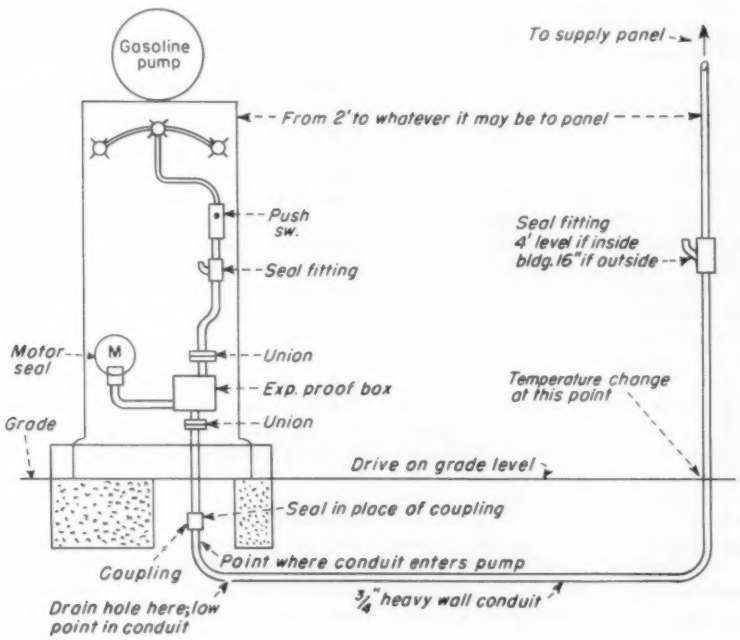
**A.** In reply to your first question which concerns Section 5120-f. 1, I have shown on your illustration the point immediately below the coupling where I believe the approved seal should be installed. It appears to me, in the case shown, that this seal should be installed in place of the coupling shown. There possibly could be a question as to where the conduit enters the pump or other equipment. Since the pump and its base are integral and the opening at the bottom is common to both, I believe the conduit enters the pump as shown. If this is correct we could not install the seal between the union and the coupling since such procedure would violate the Code rule quoted in your question.

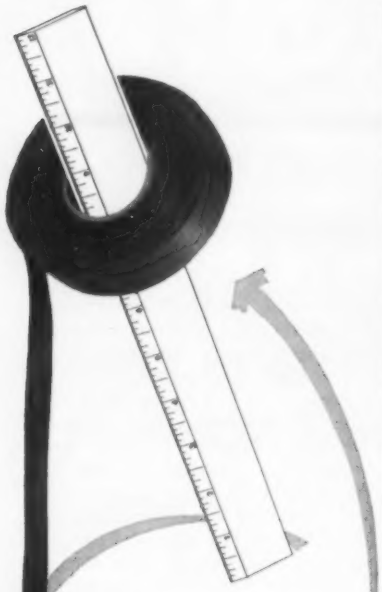
As I understand your second question, the conduit comes down the columns at the end and center of the pump island. This run is therefore in a hazardous location, Class 1, Division 1, to a height of 4-ft above the driveway level, as covered by 5120-b-1. Above 4-ft it would be outside this hazardous area. It therefore would be necessary to install a seal as you have shown at the 4-ft level as required by Section 5015-a. The note on your illustration concerning this seal appears to conflict with your description of the installation. If, as you say, the conduit comes down the post on the island it is in a Class 1, Division 1 location up to 4 ft above grade and must be sealed at this point. If, however, the conduit comes down a post outside of the island area and within 20 ft of the island, then a seal fitting must be installed 18 inches above the driveway or grade level.

It appears that the other seals shown at the pump satisfy the Code provided the switch is located more than 4 ft above the grade. At this point we leave a hazardous area and enter a non-hazardous area. The seal should be installed at the 4-ft level on either side of the boundary line as covered by Section 5015 A-2.

As covered by your third question, where the lines run underground to the inside of the service station to a panel, it would be necessary to install seals on all conduits leading to the pump island at a point 18 inches above the floor level. This is specifically required where the building is located within 20 ft of the island or a tank fill or vent pipe. See 5120-b-2. If the building were located outside the 20-ft area it also would be necessary to install seals. According to 5120-b-2 all of the area below grade of either the Division 1 or 2 location, which contains wiring or equipment is considered a Class 1, Division 1 location. It therefore appears mandatory that all underground conduits leaving the station that run through any area considered to be a hazardous area must be sealed where they enter the building. In most cases this would be 18 inches above the floor.

If the panel is recessed, the seal fittings also could be recessed and concealed in the wall. Official Interpreta-





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tion No. 369, issued April 18, 1951, applying to operating rooms, covers this point.

I note on the illustration a question concerning the change of temperature which occurs where the conduit leaves a warm building and enters the cold ground. Section 3015 covers this point and indicates that seals should be used to prevent the circulation of air from a warmer to a colder section through the raceway. This rule, however, only applies to interior raceway systems and there could be a question with respect to its application on the case in question. If it did apply it would be necessary in many cases to seal all service conduits, located on the outside walls of buildings, where they entered the building. This, as far as I know, has not been required.

I also note the drain hole shown at the low point of the conduit. Section 5015 C-5 covers this question and the rule applies to cases where there is a probability that water or other condensed vapor may be trapped within housings or enclosures or at any point of the raceway system, and also requires approved means for drainage. Underwriters' Laboratories list some drain fittings as approved but it appears that none of them could be applied as shown on the diagram. In the absence of definite provisions on this question, as you apply it, it appears that the Inspector should be consulted.—B.A.McD.

## Rewinding Motors

**Q.** *The motor from a gasoline pump at a local distributing plant was recently brought in here for service and upon opening it we found the windings had faulted and that there was considerable water in the bottom of the casing. The motor was rewound and returned to this bulk plant, but the local inspector has refused to allow them to use it as he says it can no longer bear the Underwriters' Laboratories label and therefore cannot be considered a motor suitable for use in the presence of gasoline atmosphere. Is it true that we must remove the Underwriters' Laboratories label from such a motor when it is rewound?*—R.D.

**A.** Yes. It is necessary that the label of the Underwriters' Laboratories be removed from an explosion-proof motor should it become necessary to replace the windings within such a motor or to make any other major change in the motor unless such change is made by the original manufacturer of the motor with the permission of the Underwriters' Laboratories. This is necessary because the Underwriters' Laboratories have no control or jurisdiction over various motor rewind shops and it would, of course, be economically impractical to go to the expense to make an individual visit and check of a single motor by an engineer of Underwriters' Laboratories. Therefore, where the motor is not returned to its original manufacturer but is rewound by others, the label must be removed and the motor must be considered as no longer being suitable for use in a hazardous location.

Unfortunately many persons installing explosion-proof motors neglect to acquaint the purchasers of these motors of the necessity of periodically removing condensed water vapor from within the housings or enclosures of the motors as is required by the National Electrical Code. Under paragraph c. 5. of Section 5015 you will note the Code requires that all enclosures or housings which must be sealed shall be provided with approved means of preventing accumulations of water. Periods between necessary drainage of such motor housings will, of course, vary greatly as it will depend upon the use to which the motor is placed and also upon the humidity in which it operates as a motor having a number of off and on cycles will accumulate a lot more moisture than one which runs continuously especially if the off cycles are of sufficient time for the motor to reach normal ambient temperature. You can do your customers a service by explaining to them the necessity of these periodic drainings of their explosion-proof types of motors as well as any other totally enclosed motor which they may be using.—G.R.

## The Green Conductor

**Q.** *The National Electrical Code, Chapter 2, Article 210, paragraph 2112, states: "Conductors having a green covering shall not be used for other than grounding purposes." Does this limitation apply to signal and communication conductors? If so, does this preclude the use of multiconductor cable for this type of system?—G.L.B.*

**A.** Section 2112 of the Code which limits the use of a conductor having a green covering to grounding purposes only is a provision of Article 210 which covers Branch Circuits. Section 2101 of this Article advises us that the provisions of Article 210 shall apply to branch circuits supplying lighting or appliance loads or combinations of such loads. Section 2102 infers that power and signal circuits, Article

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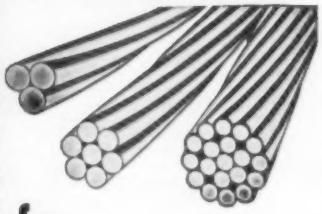

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725, would be subject to the requirements of Article 210 provided they were not altered in Article 725. Since Section 800 covering Communications Circuits are not mentioned in Section 2102, it appears that there is a question with respect to such circuits coming within the scope of Article 210.

Section 94003 covering the construction of flexible cords and the grounding conductor identification recognizes the use of a conductor having a green finish to be used as an ungrounded circuit conductor in cords having no conductor used as a grounding conductor, provided the green conductor is reidentified at the terminal ends. This provision is undoubtedly warranted in the case of flexible cords and some Inspection authorities are applying it to power and light circuits until the supply of green covered conductors has been deleted to an extent suitable for new requirements.

In view of the foregoing comment, it is my personal opinion, based on a literal interpretation of the Code requirements, that conductors having a green covering shall not be used for other than grounding purposes with the exception given for cords, and that this provision applies to all types of Branch Circuits. To me, this makes sense since in the future every time a green covered conductor is seen, the electrician would be reasonably assured that it was not a normal current carrying conductor but a conductor solely used to ground equipment.—B.A.McD.

## Street Lighting

**Q.** *We are installing a street lighting system in our town and one of the lighting standards is located at the curb but is within 20 ft of a gasoline dispensing pump at an automobile filling station. These standards have the fuse cutout block in their base approximately 8 inches above the sidewalk level and the local inspector tells us we cannot use this cutout base unless it is relocated at least 18 inches above the sidewalk level. If this is true, what can be done to make this installation comply with the Code?—R.G.C.*

**A.** Inasmuch as Section 5120 of the National Electrical Code specifies that any area within 20 ft horizontally from any dispensing island or pump of a gasoline filling station shall be considered a hazardous Class 1 Division 2 location which shall extend upward to a level of 18 inches above the driveway, it will be necessary that you either relocate this lighting standard so it will be 20 ft or more distant from this dispensing island or pump or relocate the cutout base within the lighting standard to a height of 18 inches or more above the sidewalk level with rigid conduit extending from this cutout base to a point at least 2 feet below the ground level if you are using Type USE or other directly buried conductor. If a conduit wiring system is installed between lighting standards, then the lighting standard would have to have a sealing fitting placed in this conduit above the 18-in. level and also at some other point 20 ft or more away from the dispensing island and the only practical point for that would be at the next nearest lighting standard.—G.R.

## Soil Heating Cable

**Q.** *Is it permissible to use ordinary electric soil heating cable wrapped about the tank containing crude oil to keep this oil at a certain temperature during cold weather?—T.J.B.*

**A.** Under Section 5125 you will note the requirements in this section shall include locations where gasoline or other volatile flammable liquids are stored in tanks having an aggregate capacity of one carload or more. Crude oil tanks containing crude oil should be considered as volatile flammable liquid and any electrical equipment within 25 ft horizontally or 15 ft vertically if located outdoors shall be considered as being within a hazardous Class 1 Division 2 location. Therefore the use of ordinary soil heating cable wrapped about the circumference of a tank containing crude oil would be a violation of this section of the Code.—G.R.

## NEC Official Interpretations

Four official interpretations of the 1953 National Electrical Code have been released by the National Fire Protection Association. These are in addition to the official interpretations of the 1953 Code previously released, several of which were published by the NFPA in the 1954 edition of the National Fire Codes, Vol. V, Electrical.

The full official texts of the latest interpretations are as follows:

### INTERPRETATION NO. 415

SECTION 2324; Clearance of Conductors Over Residential Driveways

*Question No. 1*—Is it the intent of Section 2324 of the 1953 Code to re-

*On all wiring in 2000-unit La Mirada project...*

# California contractor connects with SCOTCHLOKS!

REG. U.S. PAT. OFF.
BRAND

Mike Clamage, electrical contractor for the new 2000 unit La Mirada housing project in Southern California, writes: "We have been using 'SCOTCH' Brand No. 33 tape for years, but during the past year, have used 'SCOTCHLOK' Connectors in a limited way only. Some of my men preferred 'SCOTCHLOKS', while others liked crimp-type connectors. Quite frankly, I have, until now, always felt that a soldered and taped joint was the only safe and sure splice.

"I am now convinced," he goes on, "that there is a definite saving in time when using 'SCOTCHLOKS' rather than solder or crimp connectors. And the reserve spring tension of 'SCOTCHLOKS' insures a good, safe, permanent connection. That's why I'm using 'SCOTCHLOKS' and 'SCOTCH' 33 on all 2000 homes in the new La Mirada project."

Try this top team yourself! "SCOTCHLOK" is now available in four sizes—for 18 to 2 wire gages, and "SCOTCH" 33 is sold in the popular ¾ in. x 20 ft. "Job Size" rolls, or ¾ in. x 66 ft. "Economy Size" rolls. Check your supply today!

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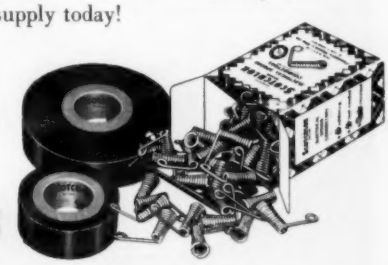

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**SCOTCH** BRAND **Electrical Products**

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*"Memory Master"* time switch is

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"TORSION-CLUTCH" DIAL DRIVE — dial turns freely for manual check of "on-off" switch operations . . . yet has positive, no-slip drive.
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SIMPLIFIED HOOK UP — with new easy-access terminal block.
FULL-DEPTH TERMINAL BLOCK INSULATOR PLATE.

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**. . . used wherever a 24-hour ON-OFF time switch is needed**

Men in the electrical field are unanimous in their praise of the new 3000 Series Memory Master. It is 100% dependable for controlling "ON-OFF" operation of bill board lights, store illumination, poultry house lighting, stoker operation and hundreds of other plant applications. It's the switch that remembers . . . lets you forget.

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Poultry House Lighting Switches
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Window Air Conditioner Switch

**PARAGON ELECTRIC COMPANY**

TWO RIVERS, WISCONSIN


quire 18-ft clearance over residential driveways when the point of attachment to the building is 10 ft or more above ground?

*Answer*—Yes.

*Question No. 2*—Is it the intent of the Code to permit a 12-ft minimum clearance over residential driveways when the point of attachment to the building must be less than 10 ft above ground and the other provisions of Section 2324 are met?

*Answer*—Yes.

NOTE: It is the intent of Section 2324 to provide clearance over residential garage driveways of the minimum distance of 18 ft wherever possible. A 12-ft minimum clearance over residential garage driveways is permitted, however, under the conditions outlined in the final sentence of Section 2324.

## INTERPRETATION NO. 419

SECTION 3105; Use of Conductors in Multiple

*Question*—Is it the intent of Section 3105 to prohibit the use of conductors in multiple larger than 500,000 CM although the current load per conductor is less than that allowed for a 500,000 CM insulated cable as shown in the proper column of Table No. 1, Chapter 10?

*Answer*—No, but the wording of the Section would indicate otherwise, so the Code Panel is recommending a change to clarify the intent.

## INTERPRETATION NO. 420

SECTION 2126-b; Lighting Fixtures on 30-Amp Branch Circuits

*Question*—In industrial and commercial occupancies is it permissible to install fluorescent lighting fixtures on 30-amp branch circuits under the provisions of paragraph b of Section 2126?

*Answer*—No. See also 2123-a, 2114, 2127, and 94103.

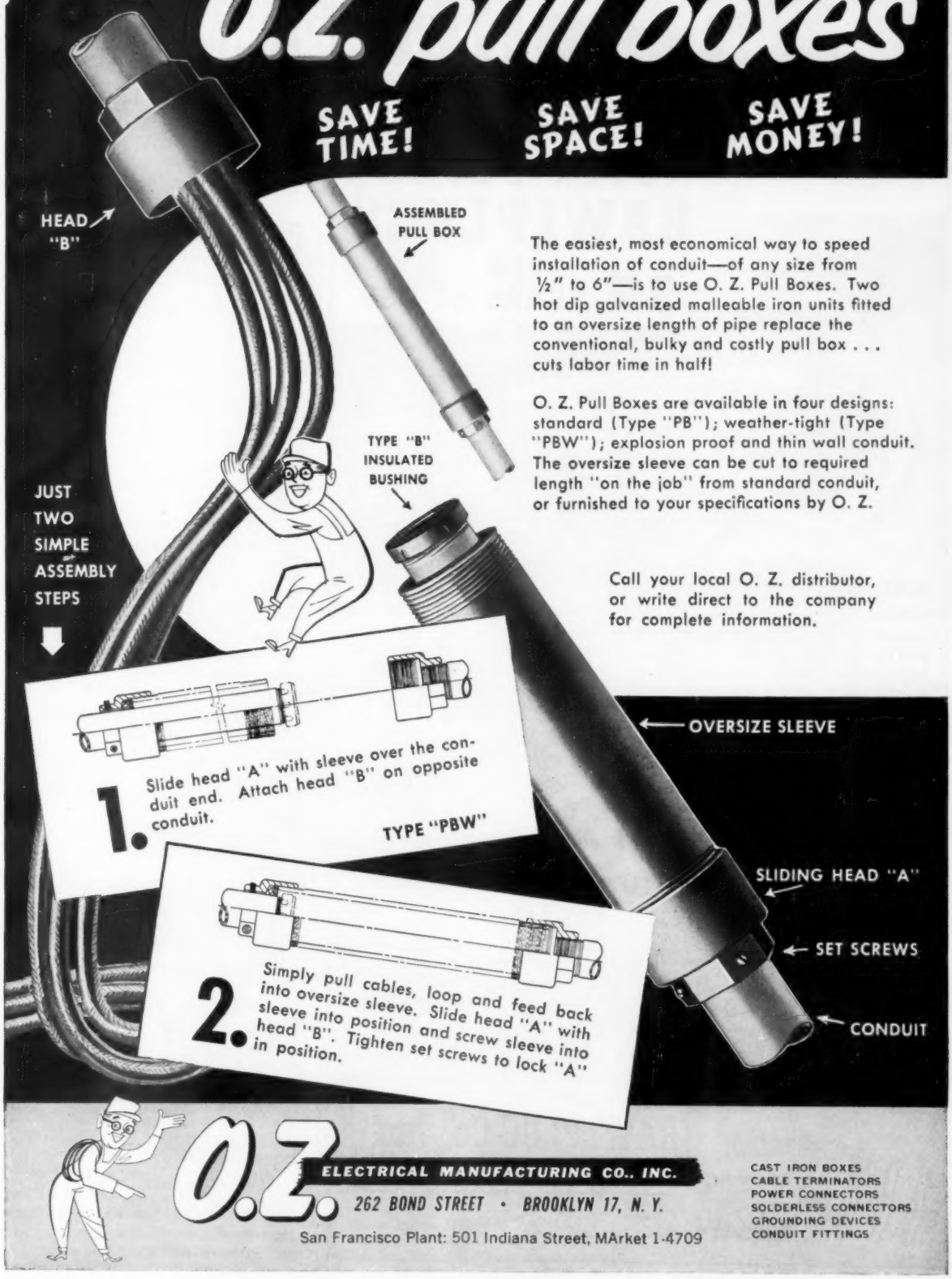
## INTERPRETATION NO. 421

SECTION 5120-f-1; Where Seals Are Required

*Statement:* Rigid conduit is run, underground, from a switch or panel in a non-hazardous area, to supply a gasoline dispensing pump, or other equipment, on a dispensing island. The conduit is sealed at the point where it enters the equipment on the island, as required by Section 5120-f-1, National Electrical Code. The conduit actually leaves the Class I, Division I, hazardous area at a point underground and 20 ft from the dispensing island.

# O.Z. pull boxes

SAVE TIME! SAVE SPACE! SAVE MONEY!


HEAD "B"
ASSEMBLED PULL BOX
TYPE "B" INSULATED BUSHING
JUST TWO SIMPLE ASSEMBLY STEPS
OVERSIZE SLEEVE
SLIDING HEAD "A"
SET SCREWS
CONDUIT
1. Slide head "A" with sleeve over the conduit end. Attach head "B" on opposite conduit.
TYPE "PBW"
2. Simply pull cables, loop and feed back into oversize sleeve. Slide head "A" with sleeve into position and screw sleeve into head "B". Tighten set screws to lock "A" in position.

The easiest, most economical way to speed installation of conduit—of any size from ½" to 6"—is to use O. Z. Pull Boxes. Two hot dip galvanized malleable iron units fitted to an oversize length of pipe replace the conventional, bulky and costly pull box . . . cuts labor time in half!

O. Z. Pull Boxes are available in four designs: standard (Type "PB"); weather-tight (Type "PBW"); explosion proof and thin wall conduit. The oversize sleeve can be cut to required length "on the job" from standard conduit, or furnished to your specifications by O. Z.

Call your local O. Z. distributor, or write direct to the company for complete information.

O.Z. ELECTRICAL MANUFACTURING CO., INC.

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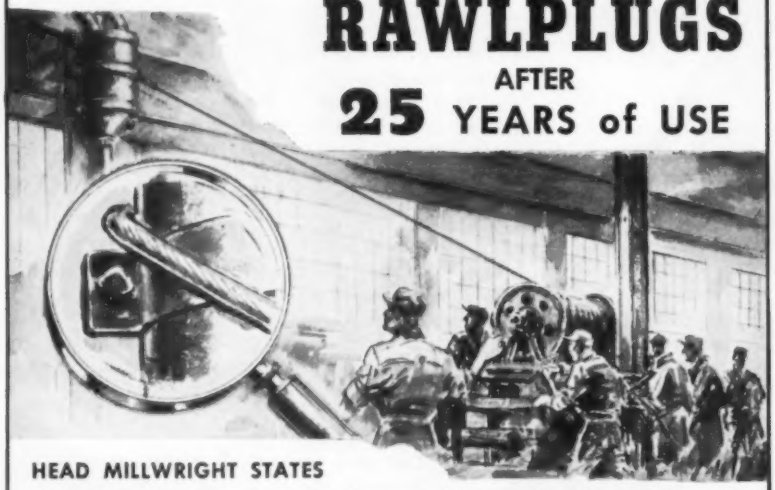
CAST IRON BOXES
CABLE TERMINATORS
POWER CONNECTORS
SOLDERLESS CONNECTORS
GROUNDING DEVICES
CONDUIT FITTINGS

NO OTHER WOOD SCREW ANCHOR
HAS EQUALLED THIS PERFORMANCE . . .

10 TON PULL

NEVER BUDGED
RAWLPLUGS
AFTER
25 YEARS of USE



HEAD MILLWRIGHT STATES

"Rawlplugs have no equal. We have used thousands. This particular dust collector to be torn down was fastened to the wall with ¼" x 2" band iron, using six ½" x 3" lag screws. We put a cable around it, thinking we could pull it from the wall. I am sure we put a ten ton pull on it and never budged it, and had to send a man up on a seat to take the lag screws out and they were as bright as when they were put up 25 years before."

(signed) E. C. Snyder
Head Millwright, Salina, Kansas.

When you require maximum holding power and the least drilling time (you drill smaller holes) use Rawlplugs.

Today more people are using Rawlplugs than ever before

WHY GAMBLE—SUBSTITUTES PROVE DANGEROUS
TRY — TEST — COMPARE

*Question*—Is a seal required where the conduit emerges in the non-hazardous area?

*Answer*—Yes.

## NEC Interim Amendments

Two interim amendments to the 1953 edition of the National Electrical Code have just been released by the National Electrical Code Committee of the National Fire Protection Association.

Interim amendment No. 100 stems from recent developments in the field of synthetic plastics and would permit the use of plastic containers for batteries. Also included in the amendment is an editorial change in Section 7013 correcting a seeming, though unwarranted, restriction on engine driven generators.

Interim amendment No. 102 specifies voltage limits for grounding receptacles rated at 15 amperes.

In accordance with established National Electrical Code committee procedure, both amendments are automatically referred to appropriate NFPA code making panels for consideration for inclusion in the 1956 edition of the National Electrical Code. These interim amendments will be included in Volume V of the 1955 six-volume NFPA National Fire Codes.

Text of the N. E. C. Interim Amendments No. 100 and No. 102 follows:

### INTERIM AMENDMENT NO. 100

(Effective May 18, 1955)

Article 700, 1953 National Electrical Code

Section 7012—Omit the word "Glass," which appears in the last sentence.

Section 7013—Eliminate the last sentence of this Section.

Section 7061—Omit the word "Glass," which appears in the last sentence of the first paragraph.

### INTERIM AMENDMENT NO. 102

(Effective May 18, 1955)

Section 2123-b, 1953 National Electrical Code

Change the second sentence of the second paragraph of Section 2123-b to to read as follows:

"Grounding receptacles rated at 15 amps and installed in circuits of less than 150 volts between conductors shall be approved for use only on potentials of less than 150 volts."

# MITCHELL Lighting chosen

## for the Imperial Camera Shop

HAROLD SOFFER, owner

Mr. Soffer's many years of experience as a store owner has made him well aware of the influence of proper store design on increased sales and properly directed store traffic.

"In my opinion," states Mr. Soffer, "the single most important element in a well-designed store is the lighting. Mitchell 'Polaris' fluorescent units were chosen for my store because of their modern design and their economical adaptation to pattern lighting installations. I have found that these fixtures provide a soft lighting effect with no disturbing glare upon glass showcases and displays."

**MITCHELL LIGHTS ANOTHER STORE**

**Imperial Camera Shop**
**Berwyn, Illinois**

**Architect:** Nerad and Carlson, Clarendon Hills, Illinois
**Electrical Contractor:** M. G. Electric, Cicero, Illinois
**Distributor:** Standard Electric Supply Co., Chicago

**INSTALLATION:** Flush-mounted MITCHELL "Polaris" two-lamp luminaires. Twelve incandescent downlights highlighting displays and major working areas. An average of 75 footcandles is maintained.

***for better store lighting, SPECIFY MITCHELL***

Write for complete details on MITCHELL store and other commercial lighting

**MITCHELL MANUFACTURING COMPANY**

**2525 Clybourn Ave., Chicago 14, Ill., Dept. 2-G**

**In Canada: Mitchell Mfg. Co., Ltd., 19 Waterman Ave., Toronto**

# Modern Lighting

## Floodlighting Complies With Specification of Limitations

Most lighting specifications are positive concerning those features which are *desired*. Therefore it was with quizzical interest that electrical contractor Dick Jones of Sharon, Mass., recently received a work order specifying only those features which were *not* wanted.

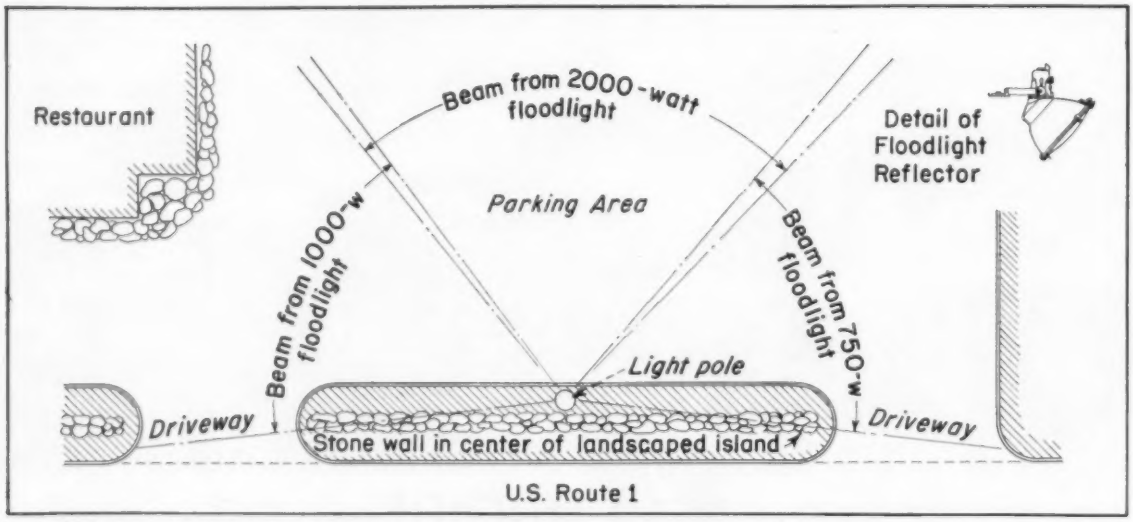
This specification concerned the relighting of a parking lot located adjacent to Lafayette House, a swank roadside restaurant in Foxboro, Mass., and the work order directed the R. W. Jones Electrical Company to "Give us a good lighting job with lots of visibility but *don't* blind the customers, *don't* blind motorists driving along the adjacent roadway, *don't* let light shine into the windows of the rest home located next door, *don't* put lighting units where they can be seen, *don't* place fixtures on any buildings, *don't* erect any poles in the parking lot, and *don't* use too much current or spend too much money."

Just for the record, the relighting was necessary because of Hurricane Hazel, for that particular big wind had blown down a large tree at the entrance of the parking lot. That tree had literally been a tree of light, because its branches had supported and shielded a total of eleven 150-watt PAR floodlamps.

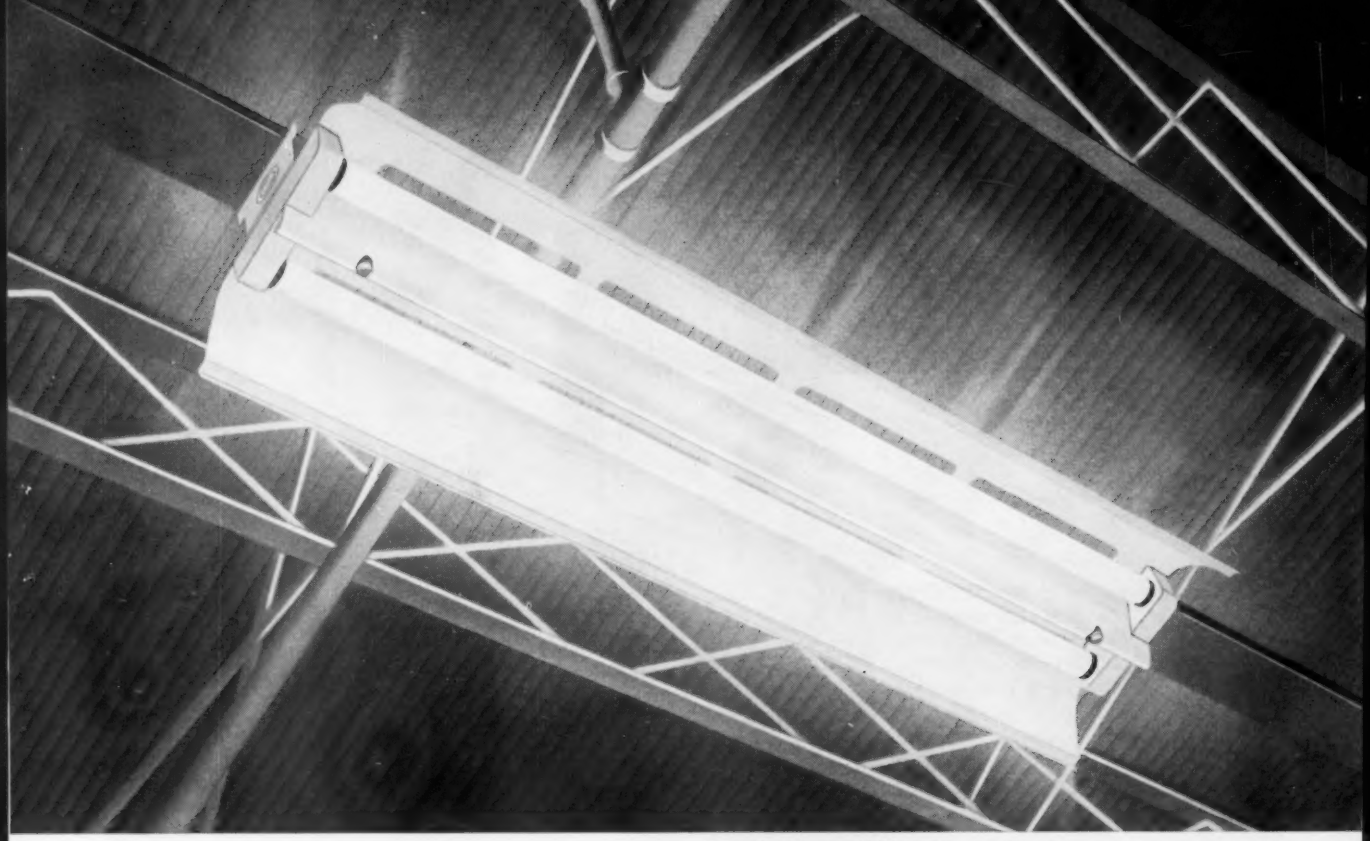
To handle this assignment, three Westinghouse VHC-18 wide-beam Alzak-aluminum reflectors were mounted atop a 40 ft Class 5 wooden pole; the three reflectors being equipped respectively with a 2000-, 1000-, and 750-watt clear lamp. This type of unit was selected because it was applicable to a wide range of lamp sizes, was easily mounted and aimed, and was readily available. Stippled glass covers provided ample diffusion, while the high elevation placed the light sources well above normal viewing angles. Furthermore, the deep reflectors provided shielding and cutoff so that glare could be eliminated with respect to the rest home next door and the roadway. And the fact that all units were enclosed and mounted on a single pole contributed to easy maintenace, wiring and relamping.

Since the restaurant was closed every Monday, the pole was erected on that day, when no-one was around the premises. Then, a week later, the reflectors were mounted and wired. By

**ROADSIDE RESTAURANT** and parking lot is illuminated to average intensity of 1.1 footcandles by three Westinghouse wide-beam reflectors mounted atop a 40-ft pole. Location of pole along stone fence separating parking area from roadway makes installation inconspicuous, and luminaires are well above normal field of vision.




**WIDE ANGLE BEAMS** slightly overlap, providing blanket illumination for parking lot while eliminating glare along adjacent roadbed. Insert shows details of Alzak-aluminum reflector and mounting bracket. Lamps used in this 3-light installation included a 2000-, 1000- and 750-watt clear lamp. Units are totally enclosed with stippled glass diffusion covers.



**Sylvania Diamond-I Line.** Like a polished gem with many facets, this new semi-direct fixture transmits *more* light—delivers a full 25% upward component, and an extremely high illumination efficiency of 89%.

# THE NEW SYLVANIA Diamond-I SERIES

## —*Untraps all usable light*

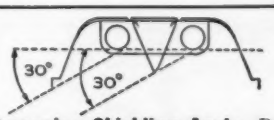
Introducing the pace-setter of an entirely new trend in plant illumination—the Sylvania *Diamond-I*. This semi-direct fixture releases light and heat that would normally be "trapped" between the reflector and the tops of the fluorescent lamps in other fixture types. It puts more light to work—provides an extremely high illumination efficiency of 89%!

In meeting or exceeding all the new RLM improved requirements for lighting, the *Diamond-I* directs a full 25% of its light upward through reflector slotting. This illuminates ceiling areas above fixtures, eliminates sharp contrasts overhead, reduces harsh shadows and glares. Its porcelainized reflector-shield spreads a full, even illumination over working areas below.

*Designed for one-man maintenance*, the Sylvania *Diamond-I* Line is engineered to cut costs to the bone. Each unit consists of only two major components—a complete channel assembly and an easily removed reflector-shield assembly. Whether an installation calls for 4- or 8-foot units, the reflector-shield is always a lightweight, easy-to-handle 4 feet long. Slots in shielding produce upward draft which carries away dust particles that would normally settle on lamps and reflectors.

• • •

You can recommend the Sylvania *Diamond-I* Line as a real investment in better plant illumination, longer fixture life, improved seeing and working conditions. Send the coupon for more detailed information.




**30° Crosswise Shielding Angle.** Provides superior industrial shielding to guard eyes from direct glare of lamps.

**Ease of Maintenance**
One-piece 4-foot reflector-shield—easy for one man to remove for cleaning. Multi-socket lampholders simplify lamp changes.

**SYLVANIA®**

**. . . fastest growing name in sight**

LIGHTING • RADIO • ELECTRONICS • TELEVISION ATOMIC ENERGY

Sylvania Electric Products Inc.
Dept. G-40, One 48th Street, Wheeling, W. Va.

☐ Please send me detailed information on the new Sylvania *Diamond-I* fixture.

☐ Have a Sylvania lighting specialist call on me.

Name_____ Title_____

Firm_____

Address_____

City_____ Zone____ State____

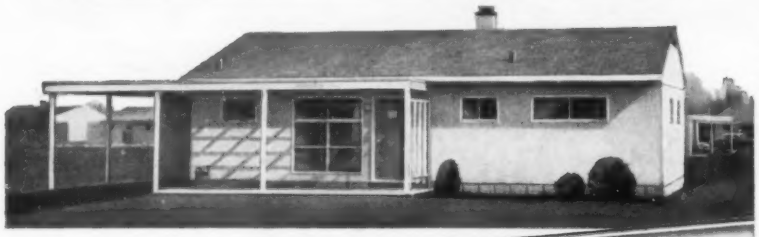
# Chicago Contractor selects Plugmold for 2,250 low cost homes

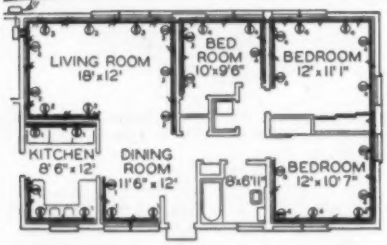
**Electrical Contractor**
**C. W. ABRELL**
*President*
Edward P. Allison Co., Inc.
Chicago, Illinois

**says:**

*"To date we have completed the wiring in the first 130 houses of the Markham project. Wiremold's new product, Snapicoil, installs easily and our men like working with it.*

*Using Plugmold wiring we can give the customer a high quality job which in turn qualifies us for a better profit."*






The floor plan of the Fisher Markham home shows location of duplex Plugmold receptacles. No. 12 conductors give Plugmold wiring ample capacity for modern electrical devices.

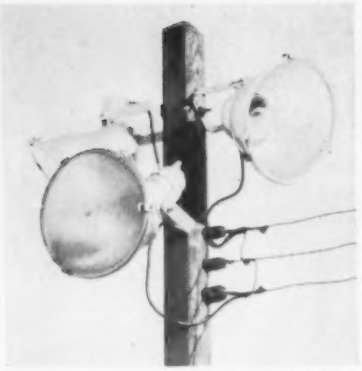
**PLUGMOLD'S**
***More-for-the-Money Value***
**HELPS SELL HOMES!**

Builder Melvin B. Fisher finds Plugmold is "a plus value which can, and often does mean a sale" in his new Markham, Illinois project, where it is being used to provide duplex electrical outlets every 5 feet in every room of the 2,250 homes. The electrical contractor selected Plugmold for these six-room $11,990 homes because it greatly simplifies installation and provides twice the usual number of outlets

***Our Engineering Department will gladly help you with specifications for Plugmold wiring. For more information, write to Dept. E-7.***

Stocked by electrical wholesalers, installed by electrical contractors ... everywhere.

**The WIREMOLD Company**
HARTFORD 10, CONNECTICUT

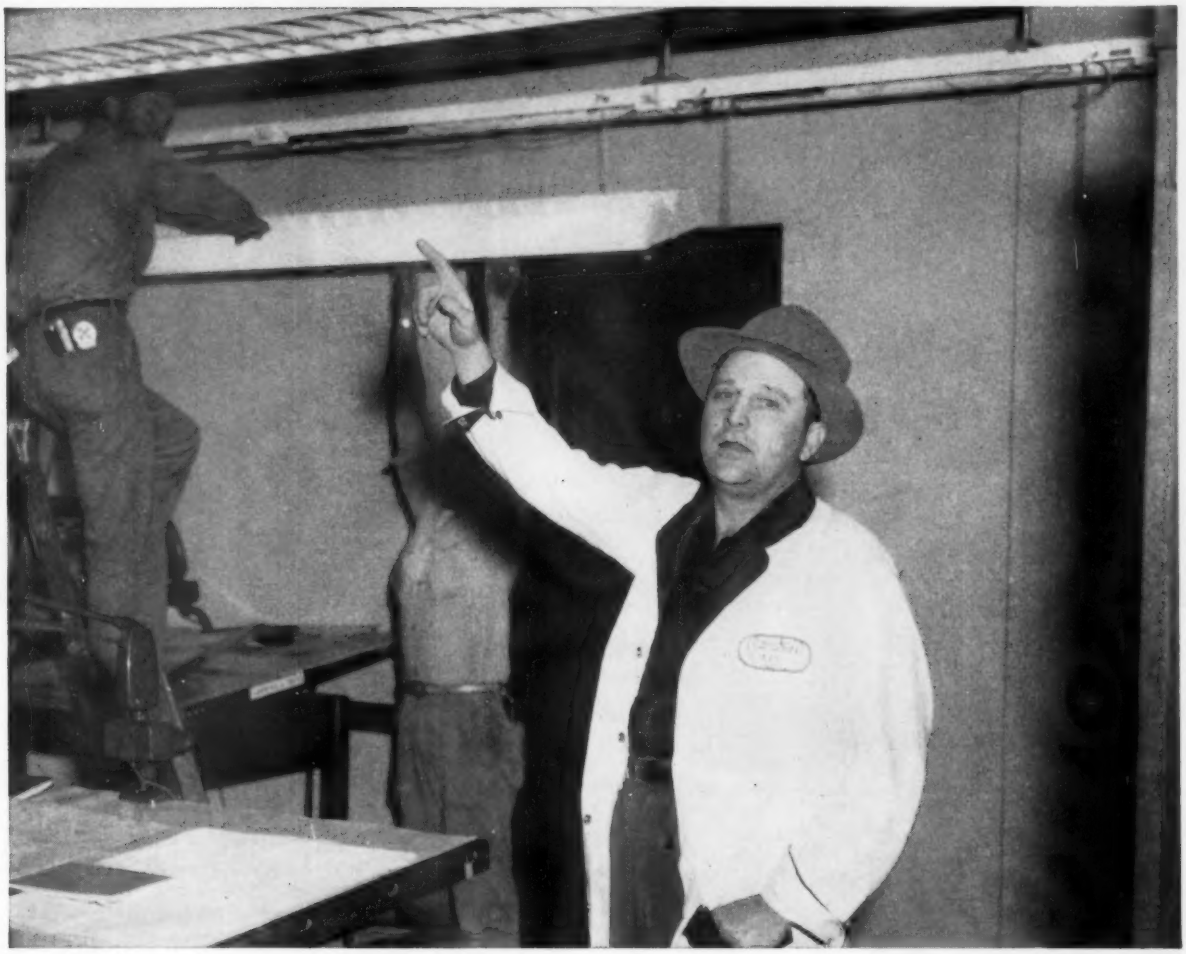



**LUMINAIRES** were selected because of their adaptability to many lamp sizes, ease of mounting and focusing, cut-off angle and maintenance facilities.

locating the pole just inside a stone wall which separated the parking lot from the adjacent roadway, the pole became quite inconspicuous both by day and by night. And, by placing the luminaires 40 feet about the ground, they also were removed from the field of casual vision.

The owner still admits that such technicalities as lumens and watts, cut-off angles, field of vision and foot-candle intensities leave him in a small fog. But he *does* appreciate his moderate power bills, his customers' satisfaction, the added visibility and safety in the parking lot, plus the fact that the pole is not an eye-sore by day or night. This, therefore, was a completely satisfactory and economical solution to a problem resulting from too much wind in too big a hurry.

**CHIEF ELECTRICIAN** Theodore H. Geisler, Nordberg Manufacturing Co., Milwaukee, Wis., is a firm believer in extra curricular educational activities. In addition to supervising a sizable electrical maintenance crew, he takes time to attend such classes as the University of Wisconsin's Electric Wiring and Estimating Institute in Madison.



A. B. Haines of Central Electric Co., Memphis, installing Day-Brite Luvex® Fixtures on a relighting job at Rotary Lift Co., Memphis.

# *Contractor Armie Haines points out a few Day-Brite advantages*

Armie Haines, co-owner of Central Electric Company, Memphis, has been working with Day-Brite Lighting Fixtures for about 15 years. Naturally, he knows what he is talking about. This is what he says:

"Since Day-Brite provides proper tooling for the manufacture of its fixtures, parts are interchangeable—installation time is speeded up.

"We save up to 25% installation time, and costs, when installing Day-Brite equipment such as the Luvex.

"Here's another labor saver—8-ft. enclosures are a distinct advantage over 4-ft. enclosures. Save time.

"Sliding clamp hangers allow for variations of hanger spacings usually encountered in relighting jobs.

"The finished job is much more satisfactory—that helps us get additional work through satisfied customers."

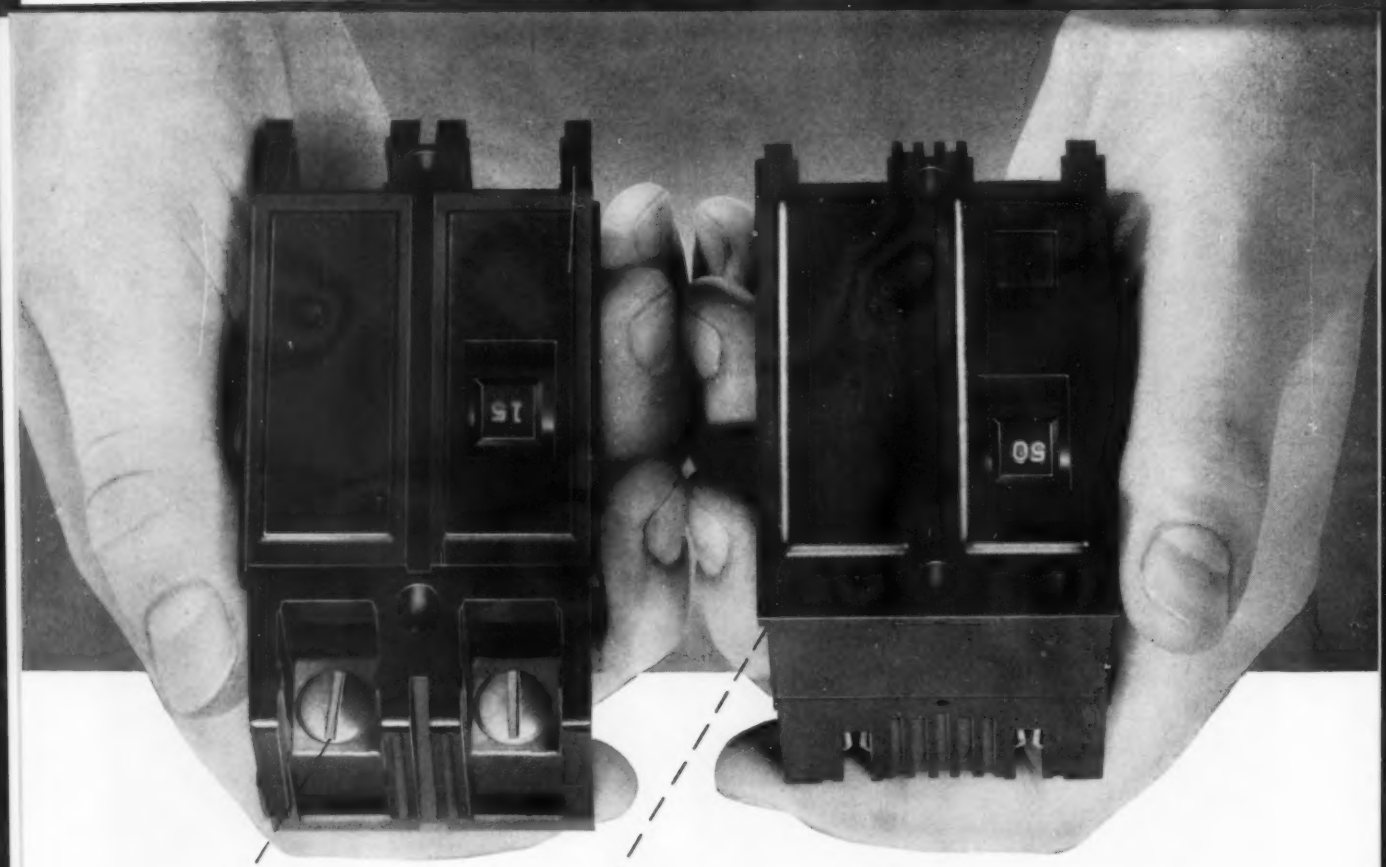
Contractors all over the United States are equally enthusiastic about Day-Brite fixtures. Profit by their experience SEE, EXAMINE, COMPARE—CALL YOUR DISTRIBUTOR.

5465

*Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Mo.*
*In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.*

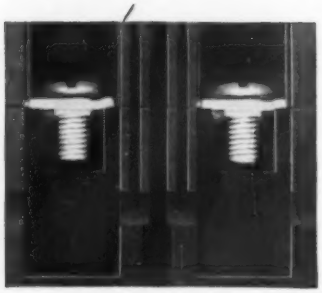
"DECIDEDLY BETTER"
**DAY-BRITE®**
*Lighting Fixtures*

**NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT**

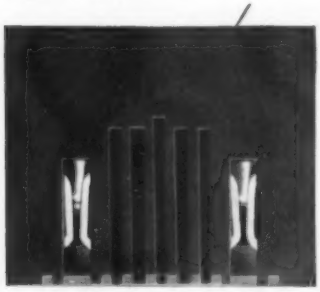



# New!

## Two-pole common-trip Quicklag® breakers —"bolt-on" or "plug-in"



**"Bolt-on" type** breaker completes the Westinghouse Quicklag line—offers a two-pole Quicklag breaker for every application.



**"Plug-in" type** breaker is firmly gripped by a female line terminal clamp plus pressure contacts on the load end of the breaker.

Whatever your choice of mountings, the new Westinghouse two-pole, common-trip Quicklag circuit breaker can now give you more flexible and efficient protection for small-wire general lighting and branch circuits. Available in 15-50 ampere ratings—120/240-volt—for a-c circuits in loadcenters, panelboards, individual applications.

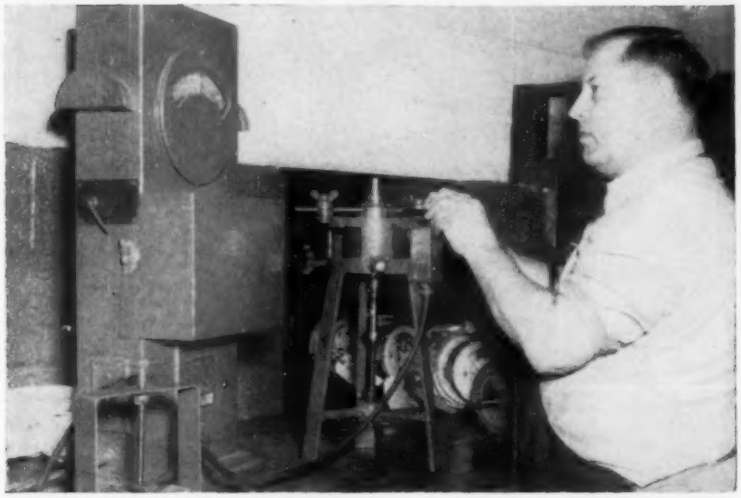
Common-trip bar opens both poles simultaneously with an overload on any one pole. Single handle indicates "trip", "on" or "off". All ratings listed by Underwriters' Laboratories, Inc.

Thermal-magnetic tripping elements, De-ion® arc quenchers, a proven quick-make, quick-break mechanism, and non-welding silver alloy contacts—all combined in electrically isolated compartments—assure protection against small overloads, instantaneous magnetic action against short circuits, and longer operating life. Call your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-30184

YOU CAN BE SURE...IF IT'S

Westinghouse

# Motor Shops



**EYES ON THE METER,** hands on the prods, armature held in position, and power switch conveniently handy, this worker in the shop of the Industrial Electric Company performs a voltage-drop test with minimum effort and time; maximum accuracy and convenience.

## Rig Holds Armature for Voltage Test

Checking voltage drop of small armatures is a fast one-man job in the shop of the Industrial Electric Company of York, Pa., where a special rig is employed to support motor assemblies atop the work benches. As shown by the accompanying picture, the rig is fabricated from strap iron, with a collar at the top and a Y-shaped brace welded near the base. The brace supports a worm screw which regulates the height of the armature shaft, while three wing-nuts at the base of the collar can be quickly thumbed tight to hold the armature steady. With these facilities for obtaining desired armature height and positioning, the commutator can be brought into proper alignment with the two adjustable test prods.

A switch on the front of the rig is conveniently available to the worker who can carry on the test without removing his gaze from the adjacently-mounted voltmeter.

## Bearings Checked After Assembly

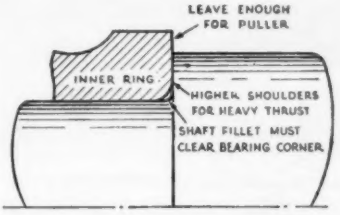
After a bearing has been assembled on a shaft, it is well to check the installation to be sure that the bearing bottoms against the shoulder. This can be checked first by making sure that it is solid, that is, that it rings under hammer blows against the pipe, or that it comes down solid on the press. For a second rough check, try to insert feelers between the inner race and the shaft shoulder, doing this all the way around.

Another check, according to the Anti-Friction Bearing Distributors Association, is to see if light will penetrate between the inner race and the shaft shoulder by holding the shaft up to a light. This, also, should be done all the way around.

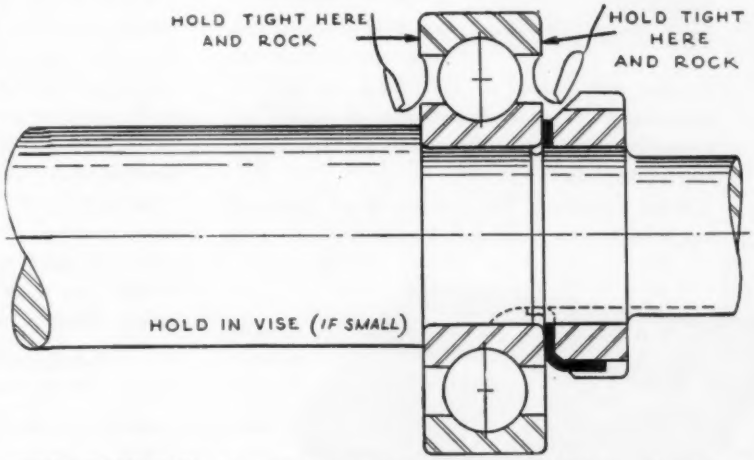
If the bearing bottoms on the shaft fillet instead of against the shoulder, it is quite necessary to remove the shaft and reduce the fillet size. Otherwise, the bearing with a turned corner radius bottomed against the shaft fillet will almost certainly be off-square, and in case there is any load against this surface, it will pound down and move once it is in use.

One should also make sure that the shaft shoulder has a sufficient seat on the ground flat side surface of the bearing. The usual practice is to make the height of the shaft shoulder about half the width of the bearing inner ring face, as illustrated in the accompanying diagram. This practice leaves sufficient surface to be gripped by a bearing puller, should it become necessary to remove the bearing.

If the shaft shoulder were small, or if there were too large a corner on the shaft shoulder, a great deal of this surface would be lost. This is espe-




**SHAFT FILLET** should clear the bearing corner when the inner ring bottoms against the shaft shoulder. Height of shoulder usually is half the width of the inner ring face, although shoulder is higher for heavy thrust pressures.




**ROCK OUTER RING** of bearing back and forth to test for radial play. Outer ring should be perfectly free and not bind. Minute radial play will permit noticeable axial movement. Small shafts may be held securely in a vise.

# Trading Water for Oil

In Southern Illinois, over twenty oil companies have wells in the 10,000 acre Lake Centralia-Salem oil field. When production in this field dropped off, these companies banded together and decided to water-flood the field by pumping water underground through former oil producing wells to force more oil to move to the remaining wells.

What happened? The amount of oil produced has been greatly increased. Today, one well that formerly produced only 5 barrels of oil a day now yields 650!

Up to 130,000 barrels of water a day are pumped into the oil field, yet with the help of automatic devices and pushbutton control, the entire operation of the field takes only a handful of men. Electric power is at work, much of it supplied through the 2500 kva Wagner transformer, shown in the foreground above, that supplies power for equipment in the injection pump house.

Wherever electric power is used, Wagner transformers efficiently and dependably handle their never-ending job of supplying proper voltages for every purpose.

Let a skilled Wagner engineer discuss your transformer needs with you. Call the nearest of our 32 branch offices or write us direct.

**Wagner Electric Corporation**
6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

WT55-7

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS–AIR AND HYDRAULIC

cially important where the bearing is to run at fairly high speeds, or is to carry very heavy thrust or shock loads.

It is also important to make sure that the outer race is still free on the inner race (except for bearings with an original tight fit-up). If the press fit on the shaft were too tight, or if the inner race were badly cocked, the bearing will bind, and that would lead to an early failure. So this is the time to discover that condition, remove the bearing, and correct the source of trouble.

The ideal bearing should still have a very slight looseness (except where a tight-fit bearing is required).

By holding the outer race tightly between thumb and fore-finger, as indicated in the diagram, it is possible to test the bearing for shake, and it is possible to detect radial play as small as .0001-in. by rocking the outer race back and forth. This is possible, because a radial play of .0001-in. will usually result in an axial tilt of as much as .006-in.

Also check to see that the bearing is still clean. If there is a lock nut and washer, be sure to wipe them off before putting them in place, especially the thread of the lock nut.

Pull the nut down as tightly as possible, for the nut is practically useless unless it is exerting a continuous and permanent axial squeeze against the inner race. Be sure that when the nut is pulled down and the lock washer is bent over, that chips are not put into the bearing.

Also make sure that you do not strike the ball cage or the shield of the bearing. Sometimes the inside surface of the nut does not correctly bottom on the bearing. It may be tapered or conical, in which case it might foul the shield or the retainer and cause trouble.

Some designs specify a hole in the lock nut to be drilled after the unit is put together. This, however, is dangerous, for then extreme care is required to prevent chips from entering the bearing.

## Power Chisel Does Many Jobs

More than 2200 electric motors a year come into the Bill Dreis, Inc., shop in New Orleans, La., for major or minor repair, and no matter how small the motor, the owner almost invariably complains that every minute it remains out of service is costing him money. To speed service to these customers, and at the same time to cut his own expenses and increase the production of his shop, Bill Dreis, president, has adopted a policy of replacing hand tools with power tools wherever possible.

Last August, Dreis purchased an air-operated, Size MC-12 Ingersoll-Rand Impacutter to replace bolt cutters, hand chisels and acetylene torches on more than ten different repair jobs in his shop. On only three of these jobs, stripping stator windings from motors and generators, installing new junction boxes, and cutting rusted bolts, the new power chisel is currently saving approximately 462 man-hours of labor per year. Dreis estimates conservatively that the Impacutter is 50% to 75% faster than hand tools. Introduction of this one tool has increased total shop production 10%.

Before acquiring its air-operated Impacutter, the shop was using a larger power chisel which, in everyday operation, proved to be too cumbersome and too heavy to handle. Since the new air chisel was acquired, the six rewinders and repair men in the Dreis shop have been using it regularly to cut time and labor on the three jobs already mentioned and the following seven: the removal of ball bearing retaining nuts, knocking ball bearings form their races, knocking out shaft pins, driving wedges, breaking spot welds, breaking screws on blowers, and cutting sheet metal. On one occasion it was used to cut a badly damaged fender from one of the company's service trucks.

The most frequent use of the air tool to date, and the one which has resulted in the greatest time and labor saving, is the stripping of windings from motors and generators. Of the estimated 2250 electric motors of all sizes coming into the shop each year, Dreis states that an average of one-third, or 750, require new windings. A repair man with the new 7½-in. long power chisel can cut the old windings on each motor and prepare them for final stripping in just five minutes. With a hand chisel or bolt cutter, the same repair man in the past required from 25 to 30 minutes.

The Impacutter is able to handle these jobs so quickly and easily because, in terms of power and blows-per-minute, it is to a hand chisel what a machine gun is to a slingshot. Weighing 3 lbs-13 oz, it can be held in one hand while the other hand holds the motor housing. Under the force of its 2250 powerful impact blows per minute, (the same length of time it requires a man with a hand chisel to deliver 40 or 50 blows) the tool's hardened-steel chisel cuts through a stator's windings like butter, leaving the stator "cleanly shaven" and ready for the furnace.

Another important assignment taken over by the air-operated power chisel is cutting new junction boxes to fit old motors. The long-standing, but frequently ignored, section of the National Electrical Code which prescribes the use of junction boxes on motors of all sizes has only recently been rigidly enforced, causing a flood of box-installation jobs in repair shops all over the country. Dreis estimates that of the 2250 motors coming into his shop each year, about one-sixth, or 375, either never had junction boxes installed, or else need their existing boxes replaced. In tackling a job of this kind, an electrician must adapt a standard junction box to fit the particular motor under repair. In the past he would do this by cutting the box to size with an acetylene torch, with heavy snippers, or with a hammer and chisel. After cutting, he would then have to grind or file the ragged edges and correct any metal warping due to excessive heat. In all, each

**POWER CHISEL** is used here to strip stator windings from a 1½-hp motor. Instead of using a hammer and chisel or a bolt cutter, the mechanic simply applies the head of the vibrating chisel to the windings at the ends of the slot, cutting right through wires.

**WELD-BREAKING** is another common application of the air-operated chisel. Delivering more than 2250 impact blows per minute, the tool is used here to remove a fitting from a 5-hp explosion-proof motor.

# SEE WHAT THEY'RE DOING with "BUFFALO" PROPELLER FANS!

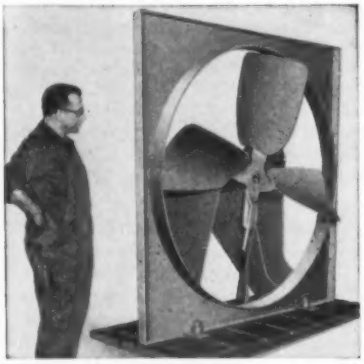
Fourteen 72" NV Belt-Airs ventilate huge new Livestock Coliseum at Montgomery, Ala., exhausting at the rate of 770,000 cfm requiring only 42 horsepower.

*Architects and Engineers:*
**Sherlock, Smith & Adams**
**Montgomery, Alabama**

*General Contractor:*
**Butler & Cobbs**
**Montgomery, Alabama**

*Heating and Ventilating Contr.:*
**McKenney's, Inc.**
**East Point, Ga.**

One bank of Belt-Airs in Coliseum. Furnished with motor-operated shutters and drive side guards.



Discharge side of 72" Belt-Air showing broad, curved blades for high efficiency at slow speeds and low noise level. Gusseted motor and bearing supports can be seen on drive side. Blades die-stamped and panel assemblies one-piece welded construction for rigidity and strength.

More and more big ventilation jobs like this Coliseum are being handled by "Buffalo" Package Propeller Fans. Users and contractors like the idea of the first cost and installation savings of propeller fans — plus the fact that this improved and enlarged "Buffalo" line give the quiet, efficient performance so necessary to satisfactory air moving. These husky packages are now cooling large boiler rooms — exhausting fumes — moving air against as much as 1" static pressure. And you can select fan sizes all the way from 8" to 144" (the 12-foot size rated at 250,000 cfm!) *Request your copy of Bulletin FM-1234* on your company letterhead and see the jobs these fans with the "Buffalo" "Q" Factor* could be doing for you.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo"

**BUFFALO FORGE COMPANY**
520 BROADWAY BUFFALO, N. Y.
*PUBLISHERS OF "FAN ENGINEERING" HANDBOOK*
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*Sales Representatives in all Principal Cities*

INDUSTRIAL EXHAUSTERS BELTED VENT SETS PROPELLER FANS "E" BLOWERS-EXHAUSTERS

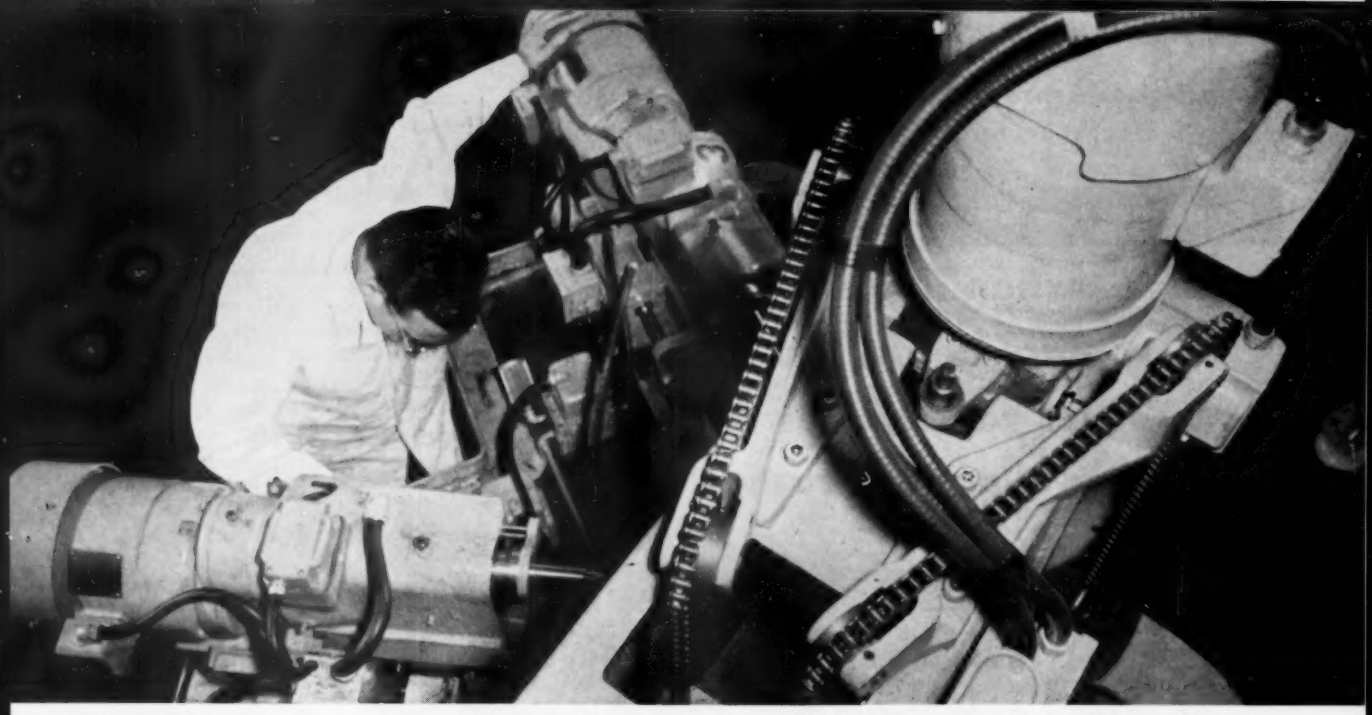

installation required an average of 30 minutes to complete, although at times a single job would drag out to 45 minutes or an hour With the shop's new air Impacutter, the same electrician requires only about 10 minutes to complete the same job. There are no ragged edges to be ground or filed, and there is no warping due to heat. The repair man simply runs the sharp cutting edge of the ripper chisel along the metal. When the job is finished, there is left a smooth, easily welded edge.

A third job on which the air chisel has introduced significant time savings is the removal of badly frozen or broken bolts, particularly from motor-driven pumps which have been exposed to the weather for long periods of time. Approximately 170 motor-driven pumps a year come into the Dreis shop for motor repairs, and of these about one-third have ten or twelve ½-in. nuts which are so badly rusted or broken that they have to be sheared off. Before the Impacutter was acquired, it was the custom to break these bolts with a hand chisel, each bolt requiring approximately five or ten minutes to break. Today, all ten bolts in a motor-driven pump can be broken in ten minutes, or one-per-minute, with the air-operated power chisel.

A full set of chisels includes a ripper chisel, a straight cutting chisel, a long cutting chisel, an angle cutting chisel, a scraper and a punch. Each is made of a special alloy steel, hardened throughout to permit repeated sharpening without danger of grinding into a soft core. They slip easily into the tool and are permanently locked in position by a spring retainer.

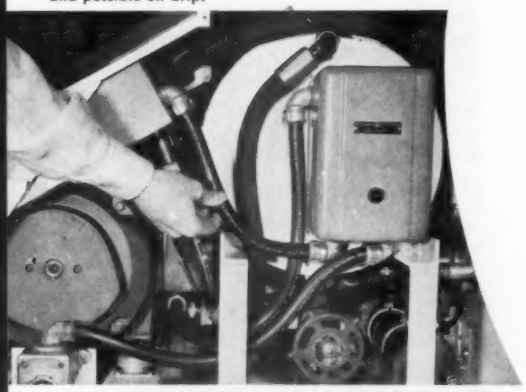
In removing ball-bearing retaining nuts, the air-operated chisel cuts hand-tool time by 50%. Instead of using a spanner wrench to run the 3-in. retaining nut on the shaft of a 7½-hp. motor, the men simply slip the blunt-end punch in the Impacutter and spin the nut off in a matter of seconds. They use the ripper chisel, with its V-shaped cutting edge, to knock ball bearings from their races, slipping the chisel through the blades of the ventilating fan, in much the same way they might slip a key through a key hole, to reach the bearings. Pullers are still used on the simple jobs; but when a stubborn bearing is encountered, which is about 40% of the time, the use of the power tool has become standard operating procedure depending on how hard the bearings are pressed on their shafts.

Another important assignment handled by the air chisel is the repair of electric welders. The power tool is used to break spot welds wherever needed and to cut sheet metal—particularly often-damaged instrument



**On Machine Tool**—Extra flexible type E.F. is readily installed, withstands flexing, protects against oil, stays tight, leakproof.

**Parking Lot Control Gate**—⅜" I.D. type U.A. makes easy U-bend, protects wiring against moisture and possible oil drip.



**In Fluid Test Machine**—Three lengths of ½" type E.F. Sealtite prove easy to handle, permit neat, fast installation without need for special tools. Test equipment manufactured by the Pacific Airmotive Corporation, Linden, New Jersey.

# FLEXIBLE—
# for faster installation!
# LIQUID-TIGHT—
# for long life! . . . It's SEALTITE

These three installations demonstrate how Sealtite* liquid-tight flexible conduit (1) protects wiring under severe operating conditions, and (2) pays its way by saving installation time.

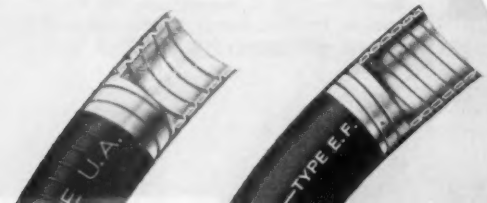
Sealtite is the *original* liquid-tight flexible conduit—met Joint Industry Conference (J.I.C.) Requirements in 1945. Wherever vibration, motion, constant flexing, wet or corrosive operating conditions or space limitations pose a tough conduit problem, it pays to use Sealtite. Installed in far less time than it takes to bend and fit rigid conduit, its tough extruded polyvinyl outer jacket keeps out moisture, oil, chemicals, the elements. Core of Flexible Galvanized Steel withstands severe mechanical stress.

*Trade Mark 55163

**ELECTRICAL WHOLESALERS** stock both types in easy-to-handle coils. Buy it in long random lengths . . . cut on the job without waste. Ask also for liquid-tight connectors from stock. For detailed information, write for Sealtite bulletins. Address: *The American Brass Company, American Metal Hose Division, Waterbury 20, Conn.*

**SEALTITE** *flexible, liquid-tight conduit*

AN **ANACONDA**® PRODUCT




**TYPE U.A.** is approved by Underwriters' Laboratories for service in wet spots. Copper conductor wound spirally inside conduit for positive ground. Jacket in black or light gray.

**TYPE E.F.** is extra flexible. Ideal for machine tool applications. Meets J.I.C. requirements. Now available from mill stocks in black, and in machine tool standard light gray at no extra cost.

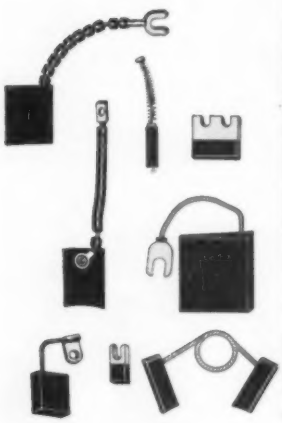
*it's just good sense...*

**Wagner replacement parts for Wagner Motors—**

**Genuine Joe Says:**

**"when it comes to replacements, the best brushes for Wagner Motors are Wagner Brushes"**

Only brushes of the *same grade* of *carbon* as the originals give you *LIKE NEW* motor performance!



There *is* a difference in carbons. "That's why, when you replace the brushes in your Wagner Motor, be sure to replace them with genuine Wagner Brushes. Replacement brushes must be of the same grade of carbon as well as the same size as the originals—in order to assure 'like-new' motor performance.

"For your Wagner Motor—maximum performance, commutator and brush life is possible only with Wagner Brushes. Identify them by the name Wagner stamped on every brush."

**Send for your copy of MU-40 now!**

Every repair shop needs this valuable electrical service catalog. It gives you the catalog number of all Wagner Motor parts. It's yours for the asking.

**WAGNER ELECTRIC CORPORATION**
**6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.**

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MOTORS · BEARINGS · STANDARD ROTORS
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**OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS**

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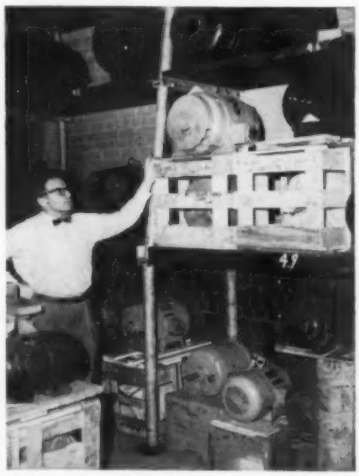
panels. In cutting instrument panels, either because the panels themselves need replacement or in order to reach interior connections, the air chisel is used in place of an acetylene torch to break the spot welds which secure the panels to their respective generator frames. As in all sheet metal-work, the powerful air chisel does this job in from one-third to one-fourth the former torch time and leaves an unwarped, smooth edge which needs no grinding or filing.

## Special Shelf Speeds Service

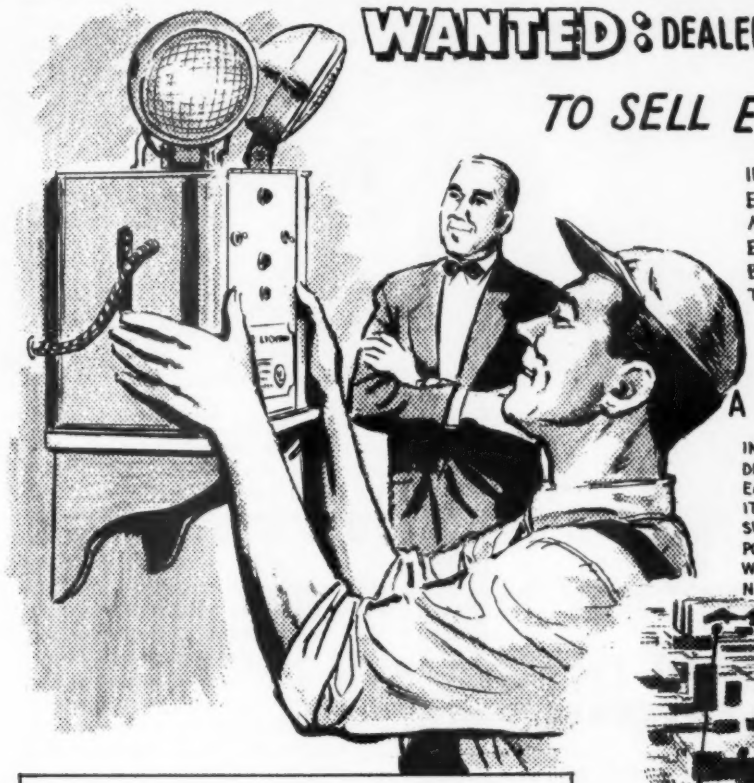
A special, shop-built shelf greatly facilitates handling and storing of large motors and has speeded up overall service at Queens Electric Motors, Inc., Jamaica, N. Y. Prior to construction of this shelf, large motors were stored on a regular shelf arrangement which often made moving and handling of motors on the shelf a difficult chore.

As shown in the photograph, the new shelf contains one level about 3 ft deep and a level above the first about 2 ft deep. With this arrangement, a person can stand up straight on the edge of the first shelf level without the shelf above pushing into his chest tending to keep him off-balance, as would be the case if the two shelf levels were the same depth. And if the two levels were the same depth a person standing on the front edge of the first level would have to hold on with one hand at all times, leaving only one hand to try to juggle and move motors on the shelf.



**SHELF FRAME** consists of vertical pipe members, horizontal angle iron and wood planks. The top level is set back from the lower level so a person can stand up straight on the edge of the bottom level and be well balanced to work with both hands.

# FACTS ABOUT Exide®
## EMERGENCY LIGHTING SYSTEMS



## WANTED: DEALERS, ELECTRICAL CONTRACTORS TO SELL EXIDE LIGHTGUARDS®!

IF YOU ARE LOOKING FOR A WAY TO MAKE EXTRA MONEY, CASH IN ON A NEW, GROWING MARKET IN YOUR OWN FIELD. BY SELLING EXIDE EMERGENCY LIGHTING YOU WILL BE HELPING YOUR CUSTOMERS PROTECT THEIR EMPLOYEES AND PROPERTY.

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IN ALMOST EVERY BUILDING THERE ARE SPOTS THAT DEMAND EXIDE LIGHTGUARD PROTECTION. YOU CAN EASILY SELL THIS EMERGENCY LIGHTING EQUIPMENT. IT IS POSITIVE INSURANCE AGAINST THE HAZARDS OF SUDDEN DARKNESS DUE TO INTERRUPTIONS OF NORMAL POWER. IN YOUR DAILY WORK YOU ARE IN CLOSE CONTACT WITH THE RIGHT PEOPLE IN THE RIGHT PLACES THAT NEED EXIDE LIGHTGUARD PROTECTION.

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THESE NEW EXIDE LIGHTGUARD UNITS ARE COMPLETELY AUTOMATIC... THEY LIGHT UP INSTANTLY— PREVENTING ACCIDENTS, PROPERTY DAMAGE, PANIC. LIGHTGUARDS ARE UL-APPROVED, TIE INTO ANY 115 VOLT OUTLET, HAVE A HIGH-RATE AND TRICKLE CHARGER. THE LONG-LIFE, RE-CHARGEABLE EXIDE BATTERY GIVES YOU BIG, EXCLUSIVE SELLING ADVANTAGES!

## YOU CAN REALLY CASH IN!

THIS IS AN EXPANDING MARKET— A REAL PROFIT MAKING OPPORTUNITY FOR YOU.

MAIL THIS COUPON NOW

EXIDE INDUSTRIAL DIVISION
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Philadelphia 2, Pa.

YES . . . I want to cash in on emergency lighting sales. Rush details on new Exide Lightguard units.

Name_____

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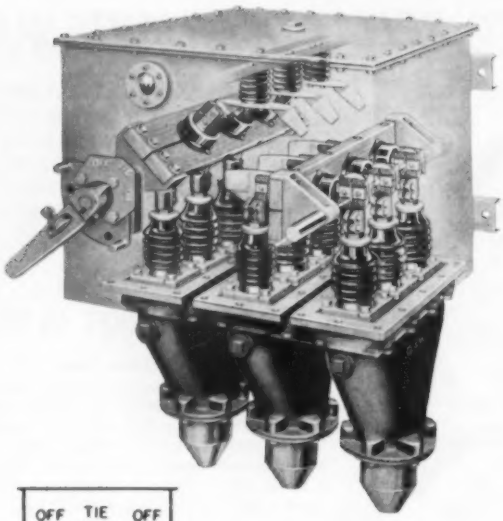
My business is: ☐ Electrical Contractor ☐ Consulting Engineer ☐ Architect ☐ Distributor ☐ Electrical Engineer ☐ Dealer

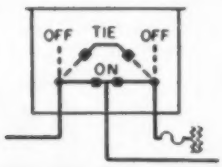
**Exide INDUSTRIAL DIVISION,** The Electric Storage Battery Company, Philadelphia 2, Pa.

**Provide safe sectionalization for**

**Cable System Flexibility**

**with G&W load-break oil switches**






**"RAL" OIL SWITCHES**

Type "RAL" oil switches with three ways (2 feeder and 1 load), two sets of links, and tie buses are designed for use on loop circuits and in other situations where similar flexibility would otherwise require three separate oil switches with correspondingly greater expense for equipment, installation, and space.

These oil switches materially reduce the length of time required for restoring service in case of trouble, or for isolating a circuit to make changes. Load break disconnection of a circuit is accomplished by manually operating an external lever—without opening the tank or breaking the oil and moisture seals.

**Standard "RAL" oil switches in 7500 and 15000 volt ratings are now assembled from stock parts for shipment in 4 to 6 weeks. Bulletin DB51 gives complete data and prices. Write for your copy or ask your representative.**

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**7780 Dante Avenue, Chicago 19, Illinois, U.S.A.**
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D521B

The frame for the shelf is made of 3-in. pipe and angle-iron cross braces. The vertical pipe members in the front are bent slightly back from vertical above the first shelf level. The vertical pipe members in the back against the wall are straight. Between each set of front and back vertical pipe members, two lengths of angle iron are bolted together, holding the vertical pipe between them. These angle iron supports rest on short lengths of steel rod through the vertical pipes. The heavy planks which make up the shelves proper rest on the angle iron horizontal members.

## C-shaped Hanger For Car-Trunk Loading

Many motors are delivered to the Industrial Electric Company's repair shop in York, Pa., by customers, who use their car trunks for hauling the motors to and from Industrial's loading platform.

So, to facilitate handling motors in these awkward spaces, Industrial's shop foreman Dave Miller employs the use of a C-shaped structural member; the top of the C being raised or lowered by a chain-hoist mounted on an overhead monorail, and the lower arm of the C slipping beneath the trunk door of a customer's car.

Since the end of the lower arm of the C is notched, it is a simple matter to slip slings over motor shafts or end bells, support the sling ropes in this notch, then raise the entire C-shaped assembly with a pull on the hoist chain.

As indicated, the C shape makes it possible for the lower arm to slip easily into the trunk compartment without striking the door.

**RUGGED CONSTRUCTION** of this C-shaped rig transmits power from overhead chain hoist, around open trunk door of car, directly into trunk compartment where motors can be carried to or from customers' premises.

**400W MERCURY VAPOR LAMP LIFE TEST INSTALLATION**: This photograph, taken in a steel service shop of Joseph T. Ryerson & Son Inc., shows Sola Constant Wattage Mercury Vapor Lamp Transformers mounted in a pendant-type, high-bay installation. Ryerson industrial engineers checked this installation continuously to record increased lamp life arising from constant wattage ballast regulation.

# Mercury Vapor Lamp Life Increased 50% with Sola Constant Wattage Transformers in Ryerson Test Installation

Getting the most mercury vapor lighting for your dollar demands consideration of factors other than lamp and transformer cost. Quality of illumination, long lamp life, and system reliability are essential for maximum efficiency and economy in mercury vapor lighting systems.

The pilot Sola-ballasted, mercury vapor lighting installation of Joseph T. Ryerson & Son Inc. shows the following advantages of *regulated* mercury vapor lamp operation: Increased lamp life, constant lumen output (often in the face of line voltage variations as great as 25%), reliability, and reduced system maintenance costs. Specifically, the following eight features can be yours when your mercury vapor lamps operate from Sola Constant Wattage Mercury Vapor Lamp Transformers:

1. *Constant light output within ±2% regardless of line voltage variations as great as 25%.*
2. *Lamps stay lit, even when line voltage drops as much as 40v (on 110v line).*
3. *Positive starting.*
4. *Elimination of primary taps.*
5. *Negligible starting current surge.*
6. *Protection on both open and short circuit.*
7. *Extended lamp life.*
8. *More ballasts can be installed on each circuit.*

These premium performance units are also available in a sealed housing for outdoor, weatherproof, commercial or industrial applications. They are particularly suitable for gasoline stations, plant protection, store fronts and parking lots.

**COMPUTING LAMP LIFE:** Here a Ryerson industrial engineer reads a service-hour register used to establish lamp life of the above installation. Lamp life is rated at 6,000 hours. At the conclusion of the test — 10,000 hours — 90% of the Sola-ballasted lamps were still operating. This is a lamp life extension of 50%.

**Write for Bulletin 17G-MV-211 for Indoor Application data and Bulletin 17G-MV-208 for Outdoor Application data.**

**SOLA** *Mercury Vapor Lamp* **TRANSFORMERS**

Regulated Outdoor

Regulated Indoor

Conventional Indoor

**CONSTANT VOLTAGE TRANSFORMERS** for Regulation of Electronic and Electrical Equipment • **LIGHTING TRANSFORMERS** for All Types of Fluorescent and Mercury Vapor Lamps. • **SOLA ELECTRIC CO.**, 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414 • NEW YORK 35: 103 E. 125th St., TRafalgar 6-6464 • PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988 • BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354 CLEVELAND 15: 1836 Euclid Ave., PRospect 1-6400 • KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382 • Representatives in Principal Cities

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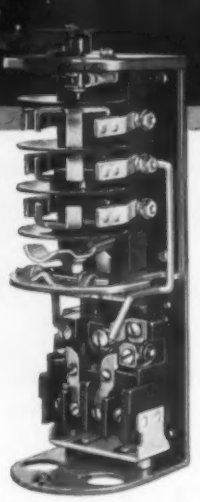

A REVERSING DRUM CONTROL with . . . BUILT-IN THERMAL OVERLOAD UNIT . . at a lower cost To You!

Only Furnas Electric offers you this exclusive feature. *Costs less than one-half what you would pay for manual reversing starters to perform the same job.*

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Write today for free 48 page catalog 5509—Furnas Electric Company, 1067 McKee Street, Batavia, Illinois.

FURNAS ELECTRIC COMPANY
BATAVIA, ILLINOIS
Sales Representatives in all Principal Cities

*Opinion*

# Let's Have "Adequate Wiring Month"

**Editor Stuart interviews Frank McKown, spark plug of Kennecott Copper's million dollar advertising campaign to inform the public on the values and benefits of adequate wiring, on his proposed plan to designate National Adequate Wiring Month for coordinated industry promotion.**

**W.T.S.:** At the Adequate Wiring conference in Chicago you proposed a united promotional effort by all the electrical industry for Adequate Wiring, united not only in objective, but in time. Just for foundation, do you have in mind a successful precedent?

**Mr. McKown:** We have an excellent precedent in the outstanding success of last year's Diamond Jubilee of Light. That program showed what the electrical industry can do when all of its resources are concentrated. Why not follow up in 1955 with an equally forceful program in behalf of adequate residential wiring?

**W.T.S.:** Would you express that more specifically?

**Mr. McKown:** Certainly. Let's have a solid month of promotion. To be specific, let's take the month of October and designate it as National Adequate Wiring Month. Let's deliver the heaviest possible concentration of advertising pressure, sales pressure and publicity within those 31 days. Let's enlist the coordinated cooperation of every trade, business and profession which has a stake in this immense market. Let's try to get every single electric utility in the United States to do something special in October. Let's urge every electrical

● ***success of Diamond Jubilee has shown us***

league to let go with its heaviest promotional barrage during that period. Let's get our contractor friends to time their local promotions to tie in with our month of intensified publicity.

**W.T.S.:** Do you think an Adequate Wiring Month would pick up other industry support?

**Mr. McKown:** It ought to. The appliance dealers have an important stake and builders should be quick to recognize the opportunity it would give them to stress greater values of better wiring in the homes they are showing the public.

**W.T.S.:** Concentration in timing might also enlist atten-

● *let's deliver the heaviest possible concentration of advertising pressure*

tion from newspapers and national magazines. Their editors must be on top of the news.

**Mr. McKown:** And it would be news. Adequate wiring is important to the public. And adequate wiring promotion is essentially public education. It goes without saying that we shall have the backing of every editor sensitive to the interests of his readers.

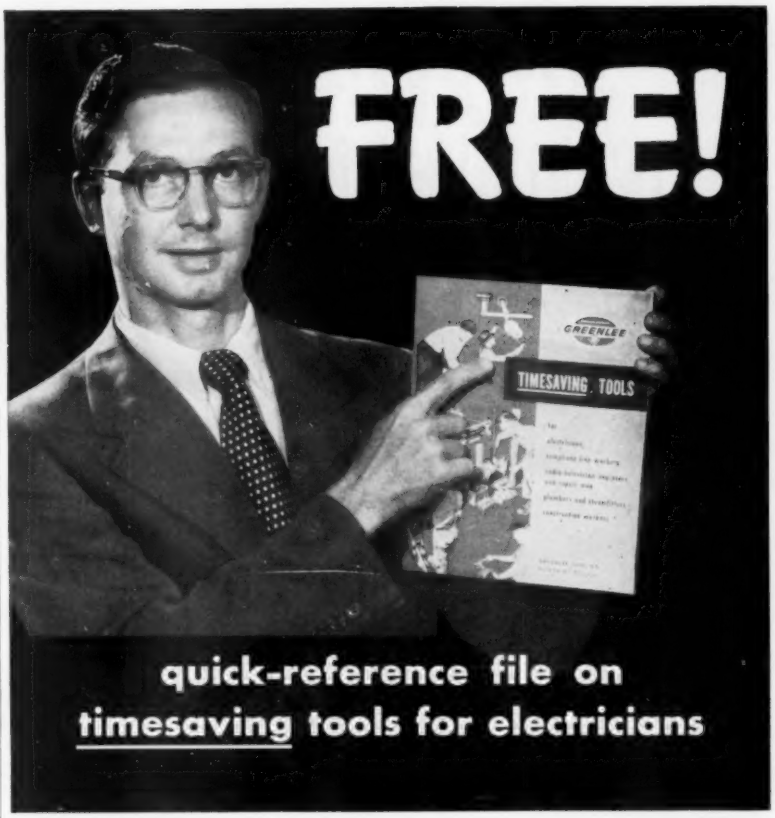
**W.T.S.:** On this I gather you are speaking from your own experience with the Kennecott campaign, and probably from your own future plans.

**Mr. McKown:** Yes. We have seen splendid editorial support for adequate wiring in the past year and with further industry effort we know that editors will give the strongest support to this campaign.

**W.T.S.:** If the industry adopts Adequate Wiring Month, would you be willing to give us an example of what you, Kennecott, might do?

**Mr. McKown:** I can promise you that if the electrical industry likes

● *we will have backing of every editor*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Please send me the new GREENLEE Electrical Tools Reference File E-212.

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The V-amp-ire preys on plants that neglect proper lighting and drains off productivity as well as current faster than you can say "bat". To keep him out, light up with efficient, long-lasting CHAMPION Lamps and follow the practical practises outlined in the Champion Maintenance Manual.*

CHAMPION Lamps

*We'll be glad to send you a complimentary copy.

**CHAMPION LAMP WORKS**

312 Lynnway, Lynn, Massachusetts


## ADEQUATE WIRING (continued)

the idea, the Kennecott Copper Corporation will run two advertisements in the Saturday Evening Post and This Week magazine during this month—or whatever month the industry selects for concentrated promotion. That alone would mean 31,000,000 impressions during the four-week period. That ought to help stir things up a little.

● ***that alone would mean 31,000,000 impressions***

**W.T.S.:** That is certainly specific. Do you feel that other national advertisers would help?

**Mr. McKown:** I am reasonably certain that other national advertisers would be delighted to prepare an ad or two on adequate wiring and could arrange to schedule them during the period of our drive. Perhaps someone would decide to take advantage of the immense opportunity of television. A one minute spot on a network show could deliver a terrific visual demonstration of what happens when wiring goes sour. Or it could show the benefits of well planned, full powered circuits.

**W.T.S.:** But what about cost? Wouldn't this campaign require a lot of new money?

**Mr. McKown:** The way I see it, this month-long promotion could conceivably be carried out without any one of us spending a penny more than our present budgets call for. What the plan calls for is a change in strategy, not budgets. The timing does it.

**W.T.S.:** As I see it, your proposal gathers its dynamics from concentration of effort at a particular time. But should we infer that this should be done at the expense of our day-to-day activities?

● ***without any of us spending a penny more***

**Mr. McKown:** No. The persistent work of the industry must go on. Adequate Wiring is a 12-month job. But concentration and timing give impact. We all know there is a great deal of spendid work being done in all parts of the country by enthusiastic and hard working industry groups. But think of the impact, think of the total force that would be generated by just taking part of this and doing it in unison in a single month.

A home owner almost could not escape exposure to this meaningful story of adequate wiring.

**W.T.S.:** A final question, who's to do the work? Obviously this is a job for an organization, preferably one now in being.

**Mr. McKown:** The National Adequate Wiring Bureau is specifically set up to take care of assignments like this. The men and women on the NAWB staff could coordinate and plan this promotion with that easy confidence they bring to every job.

But the important thing is we need a target date, a plan and a carefully timed program. Let's get the industry together and name the date. All of the elements of success are ours for the taking.

● ***think of the total force that would be generated***


FULLMAN **Latrobe**
Electrical Products

*Floor Boxes and Wiring Specialties*

ADJUSTABLE WATERTIGHT FLOOR BOXES
•
NON-ADJUSTABLE WATERTIGHT FLOOR BOXES
•
ADJUSTABLE GANG FLOOR BOXES 1-2-3 AND 4
•
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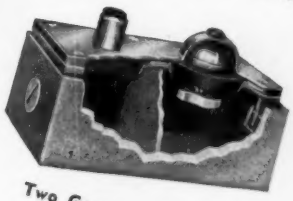
FULLMAN MANUFACTURING CO. QUALITY AT LATROBE SUPREMACY LATROBE, PA.

**Latrobe Service**

Dependable, trouble-free service has always been the chief appeal of "Latrobe" Floor Boxes and Wiring Specialties.

Easy and quick to install, "Latrobe" products serve long and well.



**Two Gang Adjustable Floor Box**

Adjustable Boxes come in single-round or square bodies. Also in square type Single Gang, Two Gang, Three Gang and Four Gang Boxes. All adjustable boxes are now bonded which makes them fire-proof.

**Non-Adjustable Floor Box**

Represents the last word in unique design, neat appearance, fewest number of parts, and least amount of labor to install.

**Insulator Supports**

Malleable iron clamps of high tensile strength. Four sizes to fit all standard porcelain or glass insulators.

**Sold Only Thru Wholesalers**

*Write for new illustrated Catalog*

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Now, from one dependable local source, WESCO ships over 85% of all orders the day they are received. This fact makes your jobs easier—and it also means you don't have to stock normal electrical maintenance and repair items.

### Nationally Known Products

WESCO carries quality electrical products with names you know and trust—and backs this line with swift, dependable delivery to save you time and money.

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### Call Locally

So, when you need electrical apparatus and supplies, call your local WESCO house—there are 118 of them conveniently located—and you can expect prompt, efficient service. See your Classified Directory . . . Look under Electrical Supplies, Wholesale and Manufacturer.

## WESTINGHOUSE ELECTRIC SUPPLY COMPANY

# In The News

## NISA Convenes in Los Angeles

**Technical papers and discussion forums occupy motor shop operators at annual national convention.**

Most versatile and reliable servant of industry—the electric motor—the economics, harmonics, repair and reconditioning of it, occupied the concentrated attention of more than 430 operators of motor shops from the entire United States to the 22nd annual convention of National Industrial Service Assn. at Hotel Statler, Los Angeles, June 6-9. Together with their wives and families, the registration totaled over 650.

While the general programs were meaty, the real substance of the convention was found in parallel sessions dealing with the problems of large motors, small motors, transformers and management. These packed the meeting halls and evoked discussion, questions and answers to problems and exchange of experience that enriched all participants. It was the pooling of the industry's know-how for the benefit of all.

Under the head of technical came three addresses, one on "Harmonics in Alternating-Current Motors" by Ray Welborn, Jr. of J & J Armature Works, Beaumont, Texas; a "Review of Problems of Temperature Classification of Motor Insulation" by Charles L. Sidway, Southern California Edison Co., Los Angeles; and one on "Single-Phase to 3-Phase Converters" by Prof. Joseph C. Hogan of the University of Missouri.

Welborn said that not much consideration had been given to harmonics developed in motor windings but told of cases where difficulty was experienced in starting and stopping by electric braking especially. He described how it could be controlled by coil span and coil grouping.

Sidway discussed insulating materials being produced at a faster rate than the industry can learn of their characteristics and discussed the prob lem of classifying them for the new AIEE standards. As a member of the AIEE standards committee he discussed the various classes of insulating ratings given, both in the United States and in Europe. By knowledge of the operating temperatures of different parts of the machine, he said, the material suitable to such operation could be selected with better skill. He demonstrated a new testing "motorette" rig by which materials for insulation are given accelerated life tests and temperature tests. He declared that the new materials mean better aging qualities and better dielectric properties and eventually will again reduce the size of motors. This may cause some problems unless the motor repair shops use the same sizes of wire and insulation in the slots of the newly designed machines.

Professor Hogan described two types of single-phase to 3-phase converters, a capacitor type and autotransformer type. Anticipating future 3-phase power, many farmers wish to purchase 3-phase motor equipment and operate it until such time from present single-phase lines. Further backing to this, he said, comes from International Harvester's announcement that it will supply 3-phase power from its portable tractor rigs to be used as auxiliary power or for emergencies. Professor Hogan emphasized the necessity for matching the motor load accurately to the capacity of the converter since

**GENERAL CHAIRMAN** of NISA Convention in Los Angeles was William M. Hogue, Larsen-Hogue Electric Co., and chairman of Finance Committee was William C. Hill, Hill Electric Co., both of Los Angeles.

**JOHN E. LAUNDER,** Independent Electric & Machinery Co., Kansas City, Mo., and Eugene J. Ther, Ther Electric & Machine Works, Chicago, Ill.

**OFFICERS OF NISA** are Paul M. Sievert, Sievert Electric Co., Chicago, secretary; Joseph H. Previty, Penn Electric Motor Co., Philadelphia, president; Charles J. Covington, Dowzer Electric Machinery Works, Mt. Vernon, Ill., vice president; G. E. Jones, G. E. Jones Electric Co., Inc., Amarillo, Texas, immediate past president; and Frank W. Ross, Ross Electric Motor Shop, Fairmount, Minn., treasurer.

WASHINGTON HIGH TO GET NEW WING
Doctors Plan Hospital For Convalescents
Night Club Zoning OK'd by Civic Body
PLANS AFOOT FOR NEW CONVENTION HALL
FAIR GROUND OFFICIALS TALK MODERNIZATION PLAN
Bus Terminal Will Move To New Location

**They're all Hot Prospects for RCA Sound Systems!**

With the exception of residences, there are few building projects these days where sound amplification hasn't an important place. It's profitable business, too, if you recommend and install equipment that's *right the first time!*

**Rely on your RCA Distributor**

Whatever the size or purpose of the installation, your RCA Distributor has the experience, the inventory to help you expedite the kind of job that will lead to others. Call on him for competent engineering assistance while the project or the sound system is in the prospective stage. He can help you avoid delays and dissatisfaction.

**CUSTOM-BUILT EQUIPMENT**
- Consoles
- Desks
- Turrets
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**INTERCOMS**
- All Master Systems
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- Combination Systems

**SPEAKERS**
- Cone Type
- Wall Type
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- Console Cabinets

**MICROPHONES**
- All types
- Stands, plugs, cables and connectors.

RCA® SOUND PRODUCTS

**RADIO CORPORATION of AMERICA**

ENGINEERING PRODUCTS DIVISION
CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

**A. J. MORRONI,** Electric Equipment & Engineering Co., Denver, Colo., and Dan Bronson, California Electric Co., Oakland, Calif.

overloads would cause serious loss in efficiency.

Under classification of shop methods there were three general-session papers. Earl S. Brooks, United Electric Motors, Seattle, told of shop management and operation necessary to make the rewinding and repairing of small motors an economic success. Ralph W. Trobaugh of Egle-Trobaugh Electric Co., Memphis, discussed a similar organization for the repair of sealed refrigeration motors. The early secrecy and lack of information from manufacturers is giving way to a freer exchange of such data that makes it possible for the independent repair shop to specialize in this type of repair work. Again sufficient volume is necessary to carry the economic end of such an operation.

A proposal that rewinding standards be set up had been made to the NISA, according to Joseph F. Ferrari, Excel Electric Co., Chicago, who had been chairman of the former rebuilding standards committee. He discussed the pros and cons of having such standards for rewinding and then listed the proposals made for such standards. He asked that the subject be discussed at

**W. S. GILES,** Giles Armature & Electric Works, Inc., Marion, Ill. and Ralph W. Trobaugh, Egle-Trobaugh Electric Co., Memphis, Tenn.

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# CRIMP CONNECTORS with the "Wrap-Cap"*

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## INSULATOR

**STRONGER... BETTER INSULATED... EASIER TO USE!**

- Provides a Perfect Pre-Fabricated Insulating Job Every Time
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Both Sleeve and "Wrap-Cap" Insulator Listed by Underwriters Laboratories, Inc., for General use (600 V.) in Branch Circuit and Fixture Wiring.

**NO EXTRA CRIMPING TOOL TO CARRY**

IDEAL All-Purpose

**ELECTRICIANS PLIERS**

(Patent Pending)

For use with IDEAL Crimp Connectors and *all around* electrical use. Crimping die makes double indentation in sleeve, increases sleeve's gripping action. New England nose gets into hard-to-reach places, twists wires, burrs conduit. Special plastic covering on handles for more comfortable grip.

*** Patented, No. RE 23649 and other patents pending**

## Only 2 Parts...

**THE SLEEVE**
Patent Pending

Cadmium-plated steel sleeve makes vibration-proof, non-crystallizing, low-resistance joint, with greater holding power.

**and "Wrap-Cap"**

Made of same long lasting vinyl material as used on TW wire. The first insulator to insulate around and between wires. Far easier to use than tape.

## PERFECT CONNECTIONS IN 3 QUICK STEPS

1. Crimp sleeve with IDEAL Electricians pliers. Clip off excess wire.
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3. Pull tabbed cap between wires and over end of joint.

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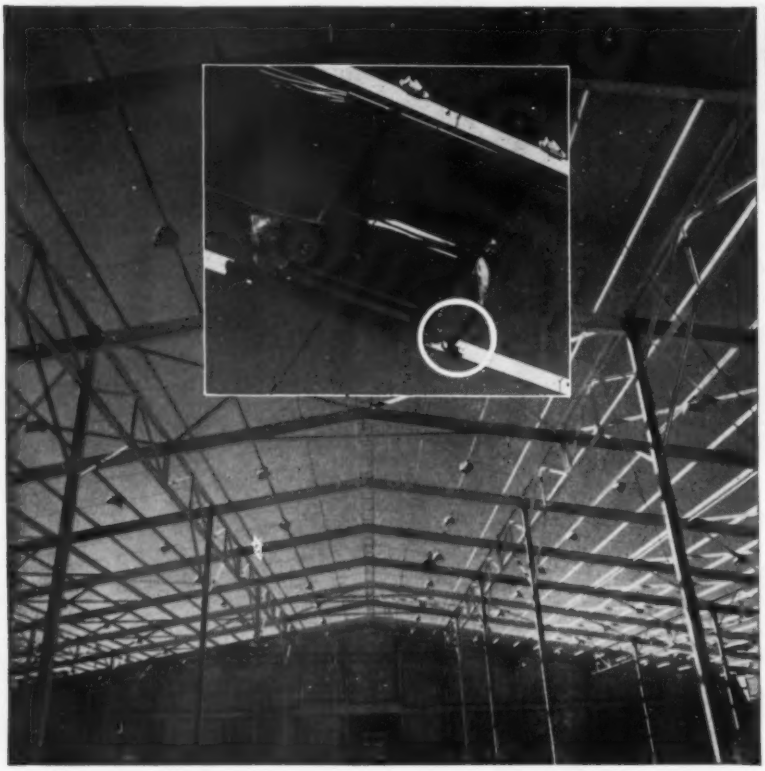

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Some 40,000 fastenings were required to install conduit and overhead lights in the warehouses of the Naval Air Station at Alameda, California.

Instead of welding or drilling holes for bolts, operators rolled along on movable platforms and anchored 3/8" steel angle plates with light, easy-to-use RAMSET JOBMASTERS and Tru-Set drive pins. Fixtures were then hauled up and fastened to the plates. Each bay of the 800-foot-long warehouse was completed in less than four days. The work was done far faster and at much lower cost than would have been possible with conventional methods, and scaffolds were eliminated.

The speed, ease and economy of RAMSET SYSTEM "pays off" on almost any kind of anchoring into steel or concrete. Reducing time up to 90% and cutting costs up to 75% are day-by-day experiences of thousands of electrical contractors and maintenance men, many of whom have been profiting from RAMSET SYSTEM for five years or more.

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**FIRST IN POWDER-ACTUATED FASTENING**

**C. S. MORAN,** Standard Electric Motor Works, Detroit; George Larsen, Larsen-Hogue Electric Co., Los Angeles; and C. Cannon, J. E. Berger Co., Detroit.

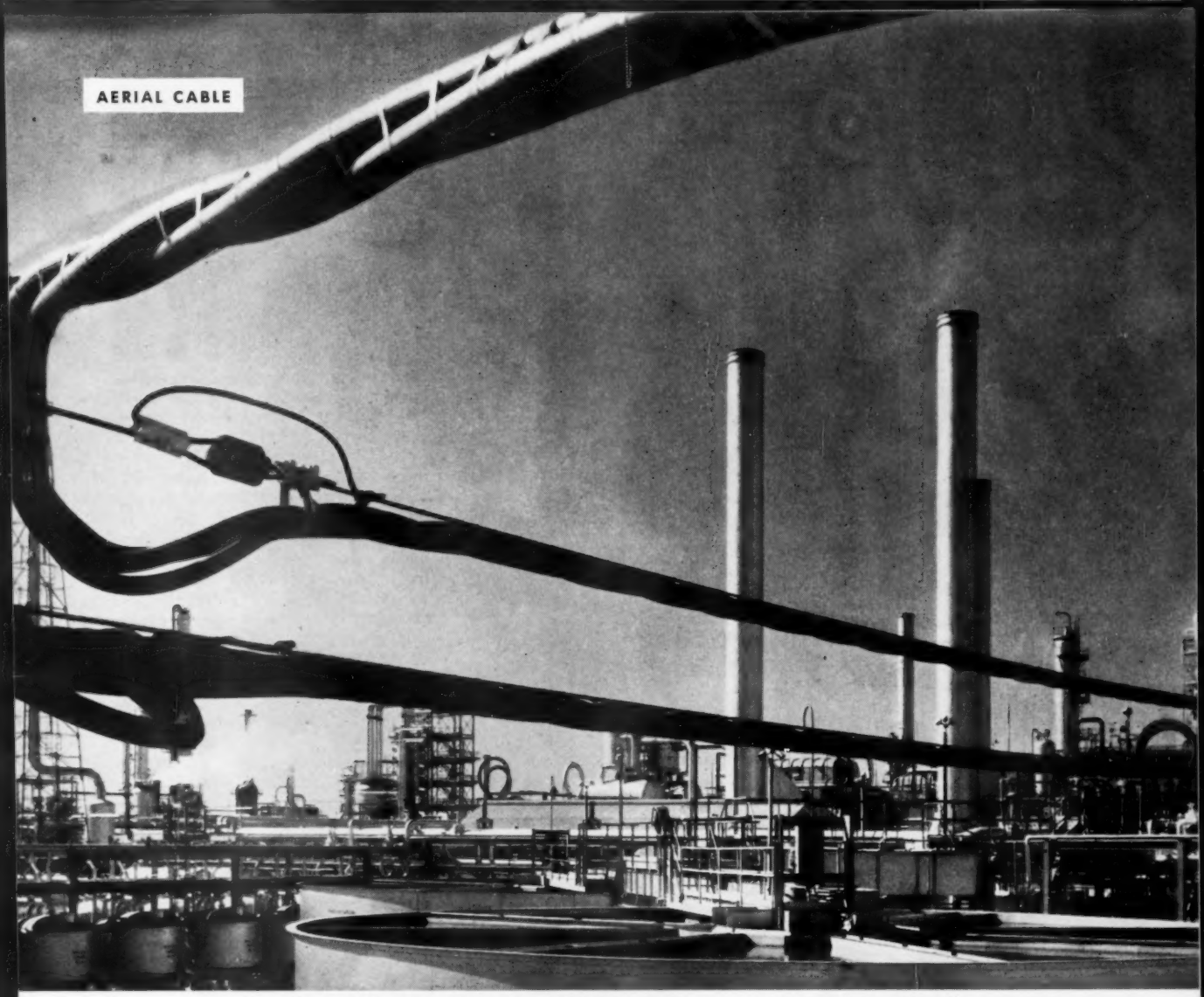
the large motor forum but was squeezed out for time and very little discussion was had over what may be a controversial matter. The point was made that the request for such standards comes from some governmental agencies who want some certification of the work they offer repair shops to do for them.

Economics of the industry dominated all the discussions and forums. The preview of the "Years Ahead for Electric Power" given by Henry B. Sargent, president, Arizona Public Service Co., at the opening session presented a panorama of future business potentials. He declared the future business depends upon continuation of the independently owned businesses of the nation, willing to take the risks and apply the enterprise to make it possible.

The annual report of sales and profits for 1954 was presented by Selden F. High, Sullivan Electric Co., Cincinnati. This survey was based on 71 reports, more than in previous years, covering a greater sales volume than previously, as well. Better breakdown of comparisons of the shops doing repair work only and those that have other functions, such as merchandising and contracting, was possible in this report. The year 1954 showed a better ratio of profit before taxes than the 7-year average since the surveys started.

As to the selling of new and used motors, Carl Lundberg, Cascade Machinery Co., Seattle, maintained there was a good market for well rebuilt and guaranteed equipment. He discussed various promotional methods and advertising ideas that could be used by the motor shop.

An economic help to the small shop was offered in the form of group insurance through the association. Paul M. Sievert, Sievert Electric Co., Chicago, and Richard C. Mattingly of New York Life Insurance Co. described in detail the plan offered to members as a group, which offers insurance to proprietors and employees on an economical basis.




**NEITHER STORM NOR HEAT NOR CORROSION** knocks out ANACONDA's 3-conductor 15kv self-supporting Aerial Cable—shown here at Shell Oil's modern new refinery at Norco, La.

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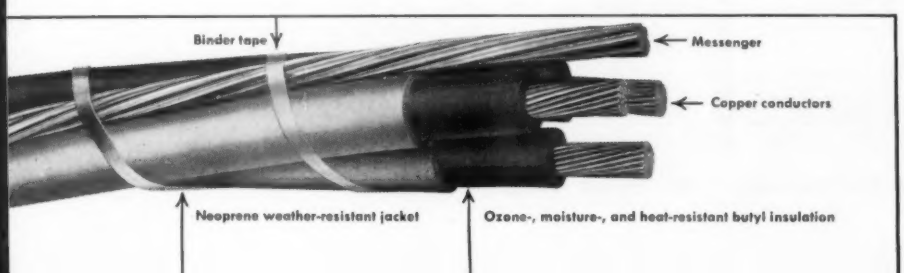
When new power is needed or when old circuits must be replaced quickly and at low cost—more and more plants are turning to ANACONDA Aerial Cable.

In plants where the maze of pipes and other underground structures often make installation of ducts or buried cable costly or difficult. This cable solves the problem.

It's fast, easy to install—particularly in crowded areas. No special ducts or crossarms or insulators are needed. Even in open areas, this rugged, neoprene-jacketed cable costs much less than buried systems.

You can see that it is neat. It is equally safe . . . and reliable!

*Today's finest aerial cable!* Type AB butyl insulation gives ANACONDA Aerial Cable the finest performance record. For the full story, call the Man from Anaconda today. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York. 55279

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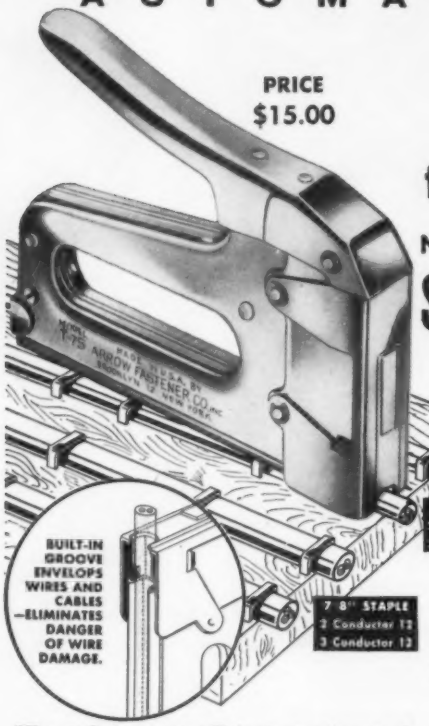
AUTOMATIC T-75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PRICE $15.00

**STAPLE GUN for stapling NON-METALLIC SHEATHED CABLE**

SAFER! FASTER! BETTER!

**PRICES**

5/8" Leg Length $2.25
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Packed 1M to box

The safest, most efficient stapling tool, ever devised for electrical wiring men! No danger of damaged wires or short circuits with special BUILT-IN GROOVE GUIDE at base of tacker. Self-feeding, automatic action permits user to staple-tack at his own rate of speed. One-hand operation frees other hand to balance self or steady object being stapled. It all adds up to considerable savings of time, money and effort on electrical wiring jobs.

GALALLOY-COATED STAPLE
a highly rust-resistant finish.
Rosin-coated for
GREATER GRIPPING POWER

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Send sample order through our wholesaler listed below.
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**CHARLES SIDWAY,** Southern California Edison Co., Los Angeles and Carl Lundberg, Cascade Machinery Co., Seattle, Wash.

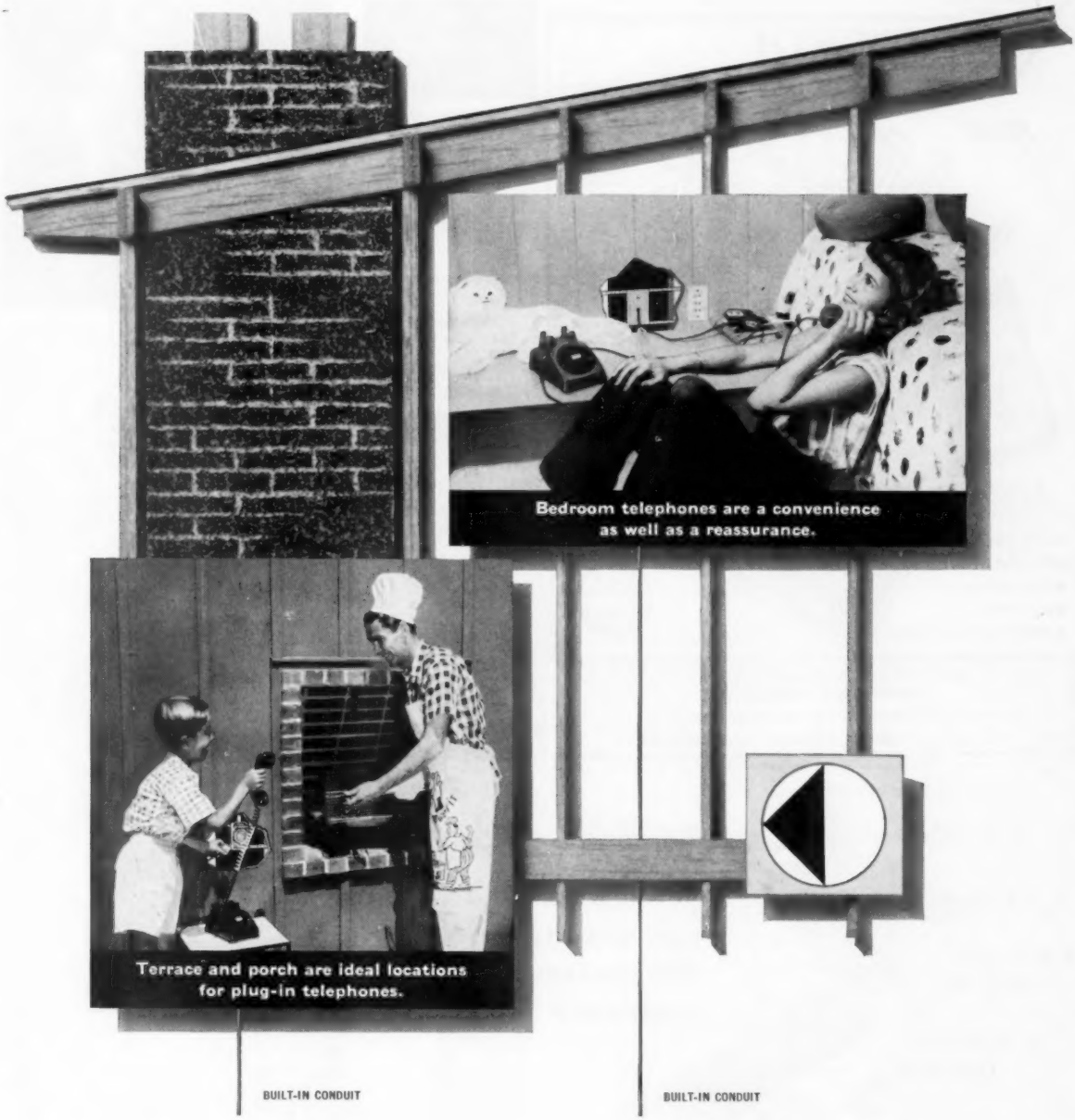
The final address was rather dramatic. It was presented by George Treiber of John C. Dolph Co., Monmouth Junction, N. J., and was illustrated by portions of moving pictures showing fire prevention methods and the hazards of handling volatile liquids. Treiber stressed the economic consequences of a fire to a motor shop and stressed the various places in the shop that needed special protection. The several types of fire require different treatment for extinguishment and the film showed the uses of water, chemicals, foam and dry powders in quenching fires.

Tours of the shops of member companies in the Los Angeles area were provided on the Thursday afternoon program. Four separate tours to cover either two or three shops were offered and buses provided to carry those wishing to view these shops. A manufacturers' exhibit containing 47 booths was also featured. The convention began with a reception for the retiring president, G. E. Jones of Amarillo, Texas.

Newly elected officers include Joseph H. Previty, Penn Electric Motor Co., Philadelphia, president; Charles J. Covington, Dowzer Electric Machinery Works, Mt. Vernon, Ill., vice-president; Paul M. Sievert, Sievert Electric Co., Chicago, secretary; Frank W. Ross, Ross Electric Motor Shop, Fairmount, Minn., treasurer. William M. Hogue and George Larsen of Los Angeles were general convention and program chairmen respectively.

## NECA Dist. 5 Meets in Ft. Worth

The Texas Hotel in Fort Worth, Texas, was the scene of the 14th Annual Meeting of District 5 of the National Electrical Contractors Association and District 7 of the International Brotherhood of Electrical Workers, May 9-12. This joint convention was organized under the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Terrace and porch are ideal locations for plug-in telephones.
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Your Bell telephone company will be glad to help you work out economical conduit installations. For details on home telephone wiring, see Sweet's Light Construction File, catalog 8i/Be, or just call your nearest business office. **BELL TELEPHONE SYSTEM**

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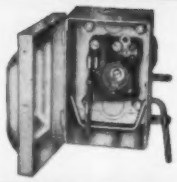

CATALOG No. 530
KNIFE BLADE
SIDE OPERATED
SINGLE THROW
FUSED — 30 AMP.
Size
D. 2¼" W. 3½" L. 5½"
NO — FUSED
OUTDOOR
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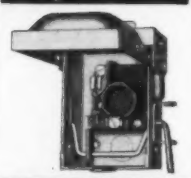

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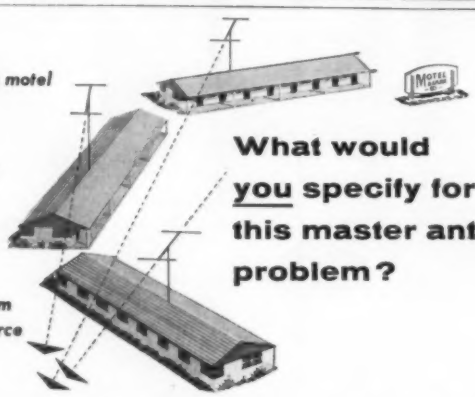
√ 3-building motel
√ 8 units per building
√ concrete on wood frame
√ 30 miles from signal source



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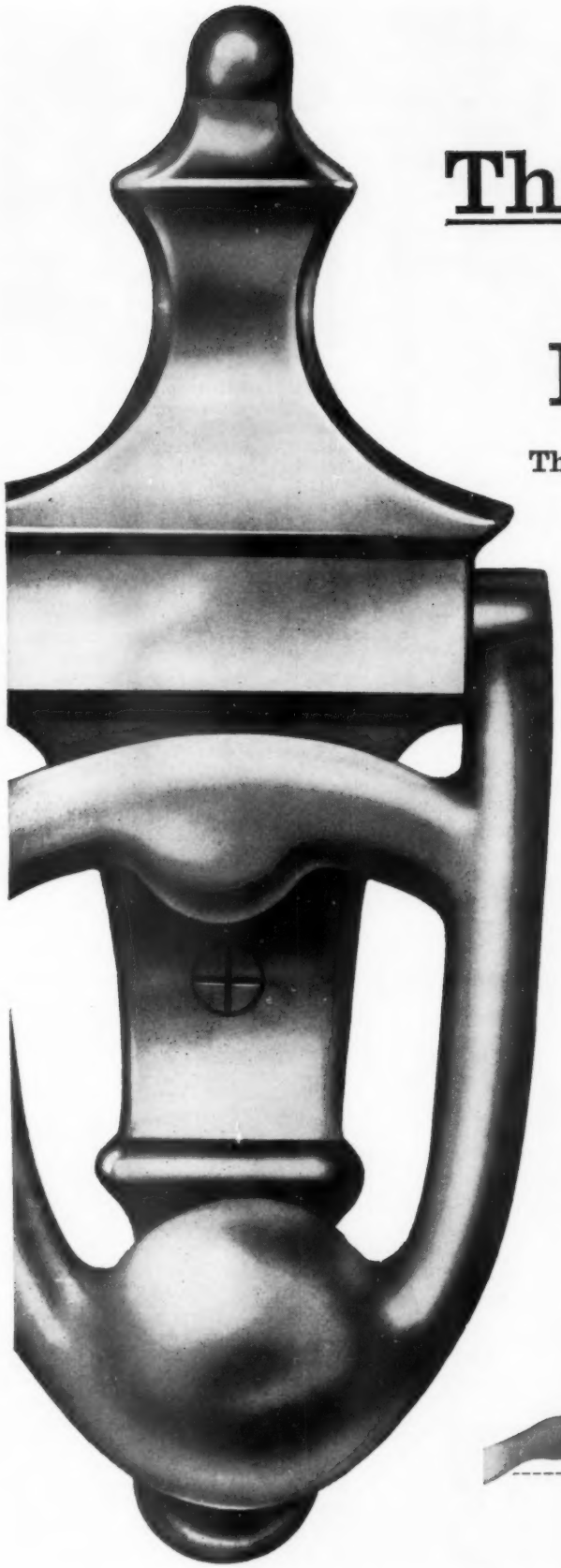
**PRIZE WINNER** in the 1954 Light's Diamond Jubilee Lighting Competition for Electrical Contractors, Bob Moser (left), Moser Electric Co., Ft. Worth, Texas, here accepts his Award Certificate from Joe McPartland (right), assistant editor of "Electrical Construction and Maintenance" sponsor of the contest. Bob, president of the Ft. Worth Chapter of NECA, won second prize in the Floodlighting classification. The presentation was made at the NECA chapter meeting in Ft. Worth.

direction of C. E. Wann, NECA Chapter Manager, Ft. Worth. Over 300 representatives of IBEW locals and electrical contracting firms—covering Oklahoma, Kansas, Arizona, New Mexico, Texas, Arkansas and Louisiana—attended this meeting.

The convention included a diversified program of business sessions and entertainment. The first two days were taken up with various organizational meetings of NECA and IBEW. On the 11th, the opening business session was led by Harold J. Hill, Hill Electric Company, Wichita, Kansas, vice president of NECA District 5. Dr. Jack Garrison, Mayor of Ft. Worth, and Bob Moser, Moser Electric Co., Ft. Worth, president of the North Texas Chapter, welcomed all to the convention. Don B. Clayton, president of NECA, spoke about the growth of the electrical industry and the role NECA is playing in that growth.

At the business session on the 12th, W. Ernest Butcher, Butcher Electric Service, Dallas, Texas, delivered an address on "Electrical Modernization". Drawing on the extensive experience his firm has had with modernization work, he pointed out the vast market which is awaiting the enterprising electrical contractor. Another very poplar part of the program was the panel on codes and standards, moderated by Frank Camus, C & C Electric Co., Shreveport, La., who for many years has been widely recognized as an authority on the National Electrical Code. Other addresses to the convention were made by: Paul M. Geary, NECA executive vice president, Wash., D. C.; and Scott Milne, International president of the IBEW.



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And for either homes or apartments the "Universal" push button model provides flexibility by mounting on door frame as well as on door.

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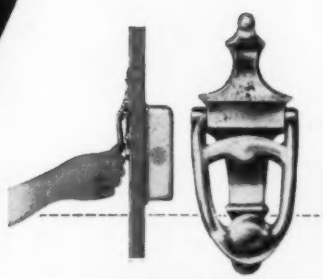

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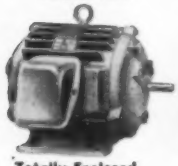

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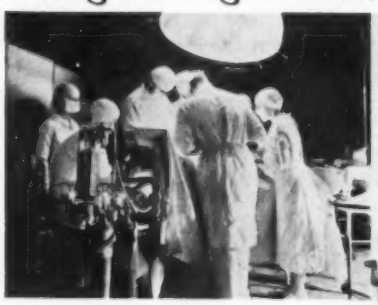

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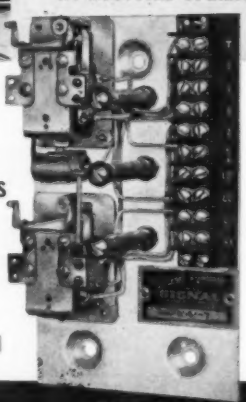

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**JACK BURTON,** president of Burton Bros. Electric Company, Ft. Worth, Texas, here takes a minute out from his office work on many details of the extensive wiring system and spectacular lighting which his firm installed in the new Ridglea Country Club, Ft. Worth.

## NALMCO HOLDS 2nd Annual Conference

The National Association of Lighting Maintenance Contractors (NALMCO), a new group originated last year in Cincinnati, Ohio, and chartered under the above name, met recently in Atlanta, Ga., for their second annual conference.

This group of lighting maintenance contractors held a three-day conference in Atlanta, April 25-27, at which time an exchange of methods, sales promotion and advertising media were the main topics of discussion. In addition to the talks made by their own members, lamp manufacturers also presented their views on maintenance methods and products.

Objectives of the Association are the proper servicing of lighting systems by regular and periodic cleaning of lamps and luminaires, prompt replacement of defective parts, and sound advice on lighting problems.

Attendance at this second annual conference totaled 30 men, representing 23 companies from 15 states, with a combined experience of 175 years in lighting maintenance work.

The Atlanta conference was closed with the adoption of by-laws, and the election of officers for the coming year as follows: president—Walter C. Fink, Jr., Senior Fluorescent, Inc., Atlanta, Ga.; secretary-treasurer—Francis Clark, Lighting Services, Waterbury, Conn.; vice presidents—Samuel Feldman, Aetna Electric Co., Allston, Mass.; Malger Gray, Tampa, Fla.; Herbert Mendelsohn, Kansas City, Mo.; Robert Watson, Denver, Colo.; and Jerome Gimbel, Chicago, Ill.

NALMCO's third conference will be held in Hershey, Pa., next year.

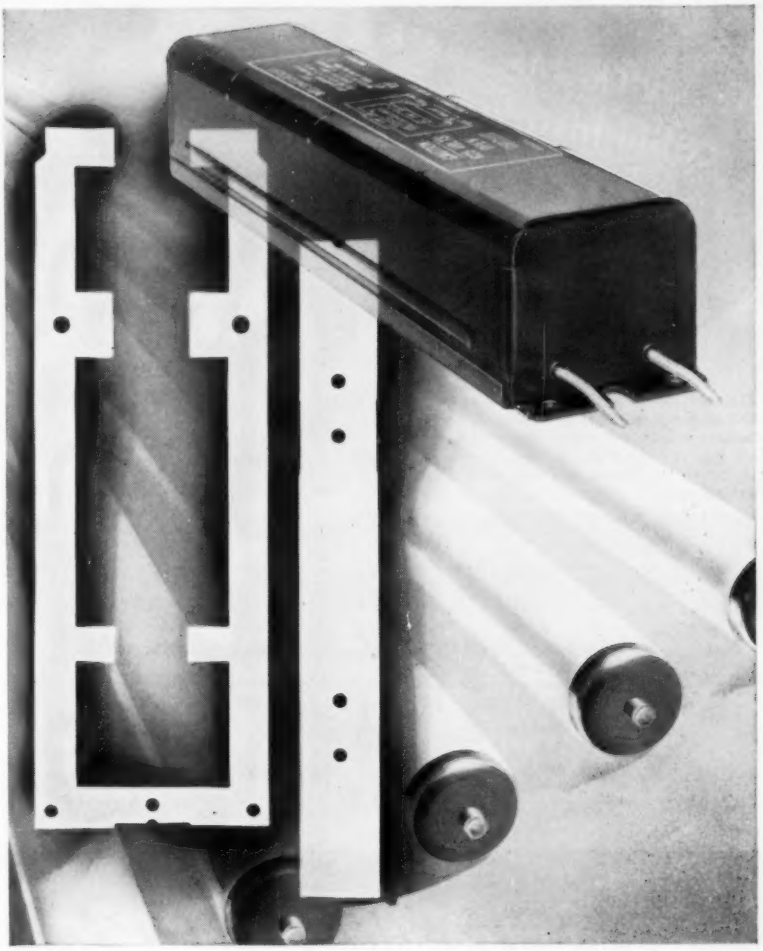
## Chicago Electrical Industry Show

More than 8,000 carefully screened representatives of electrical contractors, wholesalers, consulting engineers, architects, plant maintenance electricians, and equipment repair specialists set an attendance record at the Third Biennial Chicago Electrical Industry Show, May 10-12. Admission to the show, sponsored jointly by the Electric Association of Chicago and its Electrical Maintenance Engineers division, was by invitation only. Thus exhibitors were assured industry contacts of the calibre they most desired.

The large exhibit hall in the Conrad Hilton was filled with 156 booths manned by representatives of approximately 168 manufacturers. This compares with the first large scale show held by this organization back in 1951 when some 55 exhibitors occupied 77 booths at the Sherman Hotel. Product displays were beamed at the "select electrical people" who are responsible for the specification, design, installation and maintenance of electrical systems and equipment. There were no appliances in the show. These are displayed annually at the Electric Living Institute and Modern Living Exposition which are open to the general public.

From 1:00 pm until 10:00 pm each day, booth attendants were busy explaining features of their specific lines, pointing up new product developments, improvements on existing standard items and exploring field experience with their "customers." Product displays ran the gamut from plug fuses to power fuses, from small con-

**THE KEY** to any Adequate Wiring program is the electrical contractor, B. H. Boatner, district manager, Westinghouse Electric Supply Co., Chicago, tells Better Wiring Conference registrants. Boatner, chairman of the Chicago Electric Association Educational Committee, believes AW programs will fail to gain momentum without active contractor support.

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**Exclusive UI core design brings you double benefits. First, price has been reduced approximately 30%, giving even greater lead-lag economy—no lamp replacement guesswork—longer ballast life. Second, new design means more ballast for your money for these reasons: *Quiet*—fewer lamination joints minimize vibration. *More efficient*—new core design and clamping method reduce iron losses. *Cooler*—electrical losses are reduced and heat is distributed more evenly.**

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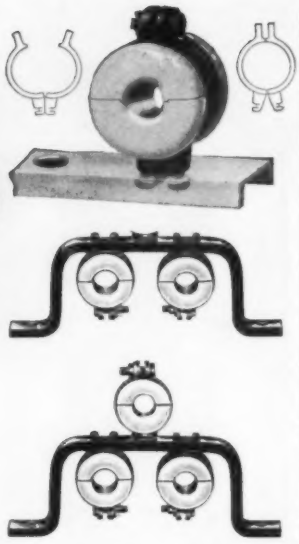
"EFFICIENCY" NESTED CONDUCTOR RACKS



Efficiency Nested Conductor Racks are simple, compact and are scientifically designed to carry conductors equidistant from center to center. One bolt supports the bushings, and clamps the bushing support to the frame. Available in 2-3-4-5- and 6-bushing racks.

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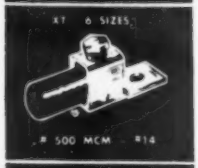

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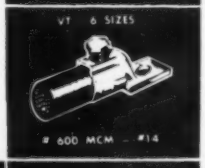
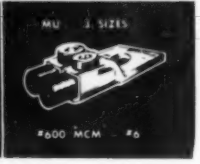





ductors to high amperage buses, from small circuit breaker load centers to large motor control centers and metal-clad switchgear. Practically every type of raceway and bus duct, fittings and wiring devices were on display as were numerous power tools and labor-saving devices. Control devices ranged from manual switch and pushbutton units to complex, interlocked, custom-built panels. New lamps and fixtures for almost any lighting application were there for the visitor to inspect as were the latest in motor developments. In fact, practically every type of equipment of interest to the electrical man was on display at the show.

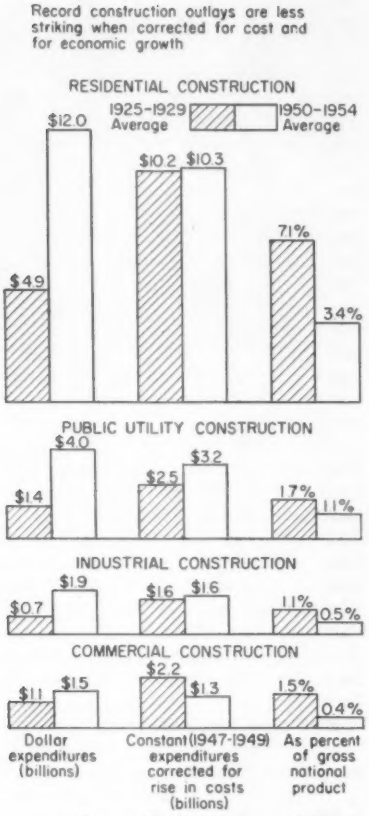
Credit for the highly interesting show goes to the 1955 Chicago Electrical Industry Show Committee headed by W. H. Boyce, Delta-Star Electric Division, H. K. Porter Company. Assisting him in planning the exhibit were: F. C. Horton, Jr., G. E. Lamp Division; D. P. Wood, Commonwealth Edison Co.; Jack Wolfe, Westinghouse Electric Corp.; H. A. Bamford, Fairbanks, Morse & Co.; G. T. Myers, Jr., Trumbull Electric Co.; John Klein, The Thomas & Betts Co.; and L. D. Cook, Electrical Maintenance Engineers, Chicago.

## Construction Boom Moderate Compared to '29

Despite record construction outlays, the physical volume of building today is moderate when compared to the boom level of the Twenties, according to a recent study by the National Industrial Conference Board. The Board, an Industry-sponsored research and educational organization, found that a sharp rise in building costs and the total growth of economy since the Twenties explain much of the present high dollar level of construction activity.

Private construction expenditures are currently running at the record rate of $28.3 billion a year, and averaged almost $23 billion during the 1950 to 1954 period as against $9 billion annually 1925-1929. It is pointed out, however, that material and labor costs have more than doubled since 1929, so that when measured in constant (1947-1949) dollars, outlays averaged only $19.4 billion in 1950-1954 as against $18.7 billion for 1925-1929. The present boom is even less impressive when related to gross national product (again in constant dollars): private construction accounted for 13% of GNP during 1925-1929, while in 1950-1954 period it ran to only 6%.

Home building continues as leader

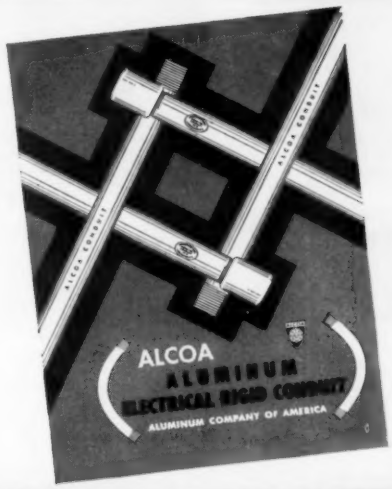



Sources: Dept. of Commerce-NICB

in private construction. Responding to a combination of long-term and short-term stimuli, housing activity had reached an annual rate of 1.5 million units by the end of 1954. Among these forces were a halt in the rise of construction costs, an increase in disposable income and more liberal FHA mortgage terms.

According to the Board's analysis, the continued trek to the suburbs has created, and will continue to create, a demand for stores, professional buildings, gas stations, shopping centers and institutional buildings. Historically lagging behind the trend of residential construction, commercial and institutional building could continue in substantial volume.

Public construction contributed over $11 billion or 30% to total new construction expenditures in 1954, with the bulk of such work keyed to continuing needs of community development and growth. The principal doubt about future volume in this field is the capacity of local communities to finance them as rapidly as they would like. Future levels of public construction activity will be determined to a large extent by the outcome of current proposals for the Federal Government to participate on a mass basis in school and highway financing.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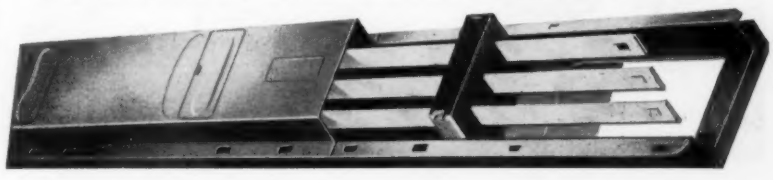

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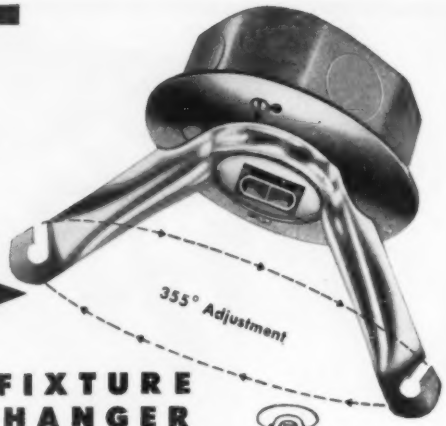


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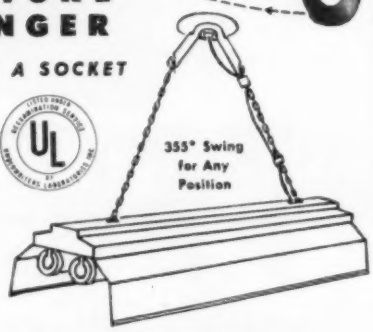


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A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

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## Midwest Contractors Meet at French Lick

Electrical contractors and their guests from Illinois, Indiana, Michigan and Wisconsin met at the French Lick Springs Hotel, French Lick, Ind., for the annual spring conference of District 4, National Electrical Contractors Association. Approximately 175 registrants participated in the business and social activities during the 3-day meeting.

Included in the business agenda were discussions on luminous-ceiling applications and market potentials, a panel on code problems and a general review of association programs and progress reports.

The subject of luminous ceiling area-lighting was ably handled by Lawson Fullerton, president, Fullerton Manufacturing Co., Norwalk, Conn.; Hugh M. Nazor, vice president of sales, Smithcraft Lighting Division, Chelsea, Mass.; and Harold Bloom, midwest sales manager, Luminous Ceilings, Inc., Chicago. Out of the formal presentations and floor discussion came the following interesting facts:

A better name for luminous-type ceiling might be "area-illumination" or "overall illumination."

A good area-illumination system must cover at least 60% of effective ceiling area and the distance from lamps to diffusing medium must be at least two-thirds the distance between lamps.

Cost of this type of ceiling can run from $1.25 to $3.10 per sq. ft. (without lamps and installation) depending upon the type of plastic diffusing medium.

No distributor or manufacturer has

**EVANSVILLE TRIO** at French Lick, Indiana, meeting of electrical contractors are (L to R): W. E. Powell, Swanson-Nunn Electric Co. (NECA governor); Clay Harris, Evansville Electric Service, Inc., (NECA Chapter president); and H. C. Pyle, Pyle Electric Co., Inc., Evansville Indiana.

**GENIAL COMPETITORS** in Gary, Indiana, are A. C. Schreiber, Schreiber Electric Co.; and Joseph Meyer, Meyer Electric Company. Duo relax before business session at four-state NECA contractor conference in French Lick, Indiana.

the right to talk "installed price" to the ultimate consumer. The lighting system is too young for this at present.

Jurisdictional disputes can arise as to which trade will install the ceiling. However, most manufacturers now support the ceiling from the lighting fixtures and this keeps it within the electrical trade.

At present there is no *electrical listing* for luminous ceilings by Underwriters. They are only found in the fire prevention lists.

In the future there will be a marking on plastic diffusers indicating a definite flame-spread characteristic—possibly a "25-50" designation.

Contractors present were particularly interested in ceiling design and suspension features.

During the Code discussion, Charles L. Smith, electrical field engineer, N.F.P.A., Chicago, reiterated the need for more training and education to assure a universal interpretation of code regulations. E. H. Herzberg related the successful experience of the Milwaukee Contractors Association in hiring a code consultant to solve this problem. Mr. Smith also revealed that the new Code may have a fine-print note recommending 100-ampere services for residences. Karl S. Geiges, Underwriters Laboratories, Chicago, revealed that new fuse developments and switch testing methods may affect the present 80% derating of fused switches for continuous operation.

Electrical construction business volume continues at a high level and will maintain this level during 1955 at least, Paul M. Geary, executive vice president, NECA, told the group. Answering member complaints on low-cost bidding, Geary reminded the contractors that the Association cannot force a competitor or member to do anything; it can only induce members to operate in a business-like manner


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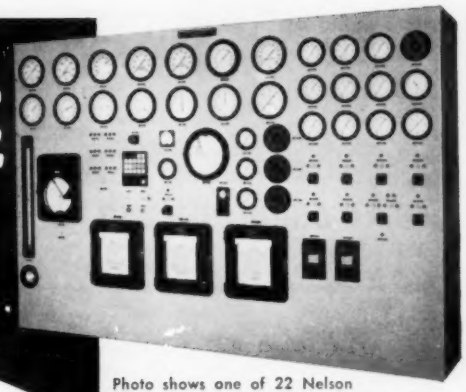
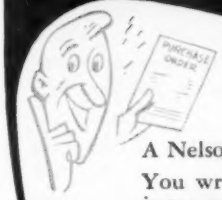


Photo shows one of 22 Nelson control boards which were recently built for a large utility.



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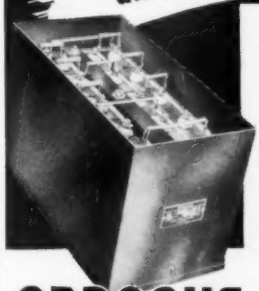

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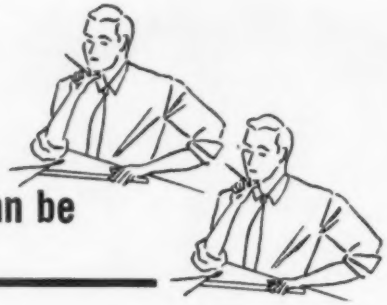

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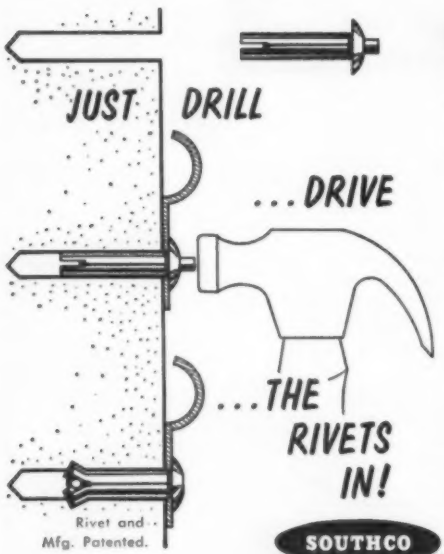


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through education. He advised contractors to depend less on highly competitive new construction for volume and go after the tremendous electrical modernization market now waiting to be sold.

Specialty contractor groups (including the electrical contractors) have a bad reputation with the federal government anti-trust authorities and that Association membership requirements and restrictions are subject to suspicion, Mr. Geary noted. The membership policy of NECA and its Chapters should not be a restrictive one, he cautioned.

Efforts are being made to free the amount of contractor money tied up on job retention percentages. A plan under consideration by architects would make the retention 10% of the first 75% of the project, then 5% of the remainder of the job.

Lyle Foster, Foster-Jacob, Inc., Peoria, Illinois, contractor, urged members to get into adequate wiring work, noted that the pay-as-you-go plans now in effect permit a contractor to do a considerable volume of this business with a relatively small investment. It is essentially a cash business from the contractor standpoint. Foster also revealed that NECA, in cooperation with the General Electric Company, is developing a test meter which will show homeowners the inadequacy of their wiring systems. Such meters will be available to NECA members only, at first, he noted.

At the convention banquet, Oliver F. Burnett, Jr., Chicago and Lyle Foster, Peoria, were presented with award plaques. Mr. Burnett's was for his chapter and association activities with respect to business promotion in the electrical construction industry, Mr. Foster's for his activities in behalf of adequate wiring.

## NISA News

An Open House to celebrate the 35th anniversary of Tri-State Armature and Electrical Works of Memphis, Tenn., was held May 27-June 3. The firm also published a 12-page booklet in commemoration of the event.

• • • •

The first annual "Technical Forum on Electrical Equipment" sponsored by Southeastern Chapter was a history-making event for that chapter and the 165 men who attended it in Charlotte, N. C., April 15 and 16.

Comparable to a seminar, the forum, held at Hotel Selwyn, concentrated on purely technical matters. There was no social activity or registration fee.

George F. Stratton, Armature Winding Co., W. W. Hanks, NISA's first president, Southern Electric Service Co., and Carlton A. Andrews, Jones Electric Repair Co., representing NISA's three Charlotte members, were the forum committee. Andrews presided at the morning session which began with a discussion of the NEMA re-rating program by John F. Merriell of Fairbanks-Morse Co., Freeport, Ill.

J. J. Kirkish, chief engineer of Louis Allis Co., the next speaker, discussed "Basic Winding Calculations," covering basic design and calculation from iron dimensions and data. Kirkish distributed a booklet, "Basic Winding Calculations of Polyphase Motors," to the audience before his talk.

The following day, George Stratton presided at the morning session. Sam Heller, NYC, discussed "Rectifiers, applying and servicing." The subject was chosen because the committee felt there is increasing use of rectifiers, particularly in textile, welding and printing fields. Russell Ranson of Ranson-Wallace Co., distributors in Charlotte of Weston Instruments, discussed meters.

He was followed by William N. Reese of National Electric Coil Co., Columbus, Ohio, whose topic was "New Insulation," described in the program as "an unbiased opinion on all new insulations available and their important part in the new NEMA frame."

• • • •

Three-fourths of the members of North Central Chapter registered at the chapter's spring meeting April 16 at St. Paul, Minn. NISA President G. E. Jones, Region 11 Director Thomas M. Paul and Ivan Pixler, president of the Midwestern Chapter, also attended. The group heard Gil

**TWIN-CITIES PACKAGE** plan for residential rewiring is topic of this serious huddle between John Mester (left), Mester Electric Co., Minneapolis; and Stan Sayre, Minn. State electrical inspector, St. Paul, at electrical industry conference in Minneapolis. During first month of plan operation, more than 60% of inquiries resulted in rewiring sales.


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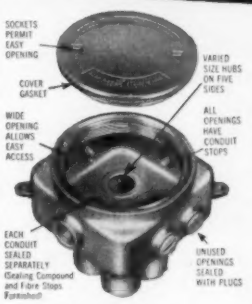
**EXPLOSION-PROOF Sealing JUNCTION BOXES**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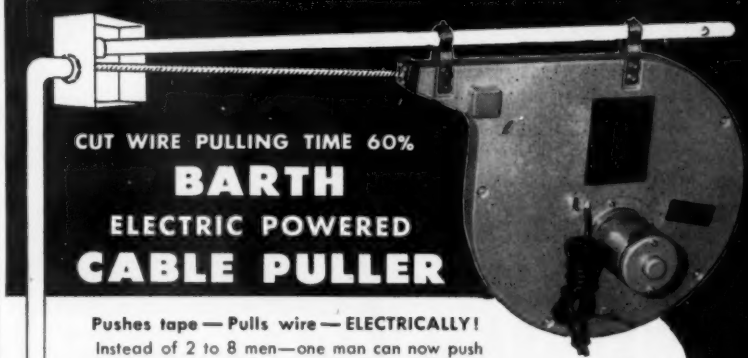

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Bock of H. A. Holden, Inc., discuss causes of commutation troubles and remedies. General shop discussion, followed by a tour of St. Paul's A & P Electric Co., concluded the meeting.

Officers re-elected for a second term are: president, Warren Mielke, Mielke Electric Works, Duluth, Minn.; vice-president, Gordon W. Kunde, Benson Motor Electric, Brainerd, Minn.; and secretary-treasurer, J. J. Anderson, A & P Electric Repair, St. Paul.

• • • •

"Aimed right at your profit-and-loss account" is the way Quaker City News, peppy monthly bulletin of that chapter, described its April 13 meeting. "One problem common to all of us is the matter of pricing our work. Not the number of dollars we charge, but the method we use to arrive at our figure," the News stated. Milton Eisenhardt of Merchantville, N. J., chapter president, Ralph O. Kufen of Hatboro, Pa., NISA Vice-President Joseph H. Previty, Penn Electric Motor Co., Philadelphia, and Harry Rezer gave some concrete examples, using factory pricing as a guide.

• • • •

Frank W. Willey, NISA's director emeritus, was honored with a life membership and a set of luggage by Cincinnati Chapter on April 20. The former president of Willey-Wray Electric Co. retired April 30.

• • • •

Southwestern Chapter changed its fall meeting site from Tyler to San Angelo, Tex. The date: September 8 to 10 at Cactus Hotel. W. W. Jackson is program chairman.

• • • •

The New York Metropolitan Chapter meeting was held May 19, at the Shelbourne Hotel with 46 members and associates in attendance.

The Anaconda Copper Company film shown at the meeting gave a very good picture of every phase of copper production, from ore to finished wire.

Bill Kauppert gave a report regarding the 10-man New York delegation visit to the Syracuse, N. Y. Niagara Chapter meeting.

Meyer Friedkin briefly reviewed Frank Willey's important and informative new book on the history of NISA.

Karl Meyerstone, Jr., Premier Electric Company, was welcomed back from military service.

Walter Leirer disclosed that the chapter is planning to hold a foreman's meeting next February.

*From Walter J. Prise, Queens Electric Motors, Inc., Jamaica, L. I., N. Y.*

## DATES AHEAD

**Western Plant Maintenance Show**—Los Angeles, Calif., July 12-14.

**Western Electronic Show and Convention**—San Francisco, Calif., August 24-26.

**Electrical Conference of the Petroleum Industry**—Sponsored by the Petroleum Industry Committee and the Houston Section of the American Institute of Electrical Engineers, Shamrock Hotel, Houston, Texas, September 12-14.

**Illuminating Engineering Society**—National Technical Conference, Statler Hotel, Cleveland, Ohio, September 12-16.

**National Association of Electrical Distributors**—Pacific Zone, annual convention, Empress Hotel, Victoria, B. C., Canada, September 25-28.

**International Association of Electrical Inspectors**—Northwestern Section, Bellingham Hotel, Bellingham, Wash., Sept. 12-14; Southwestern Section, Mission Inn, Riverside, Calif., Sept. 19-21; Western Section, Nicollet Hotel, Minneapolis, Minn., Sept. 26-28; Southern Section, Jung Hotel, New Orleans, La., Oct. 3-5; Eastern Section, Mark Twain Hotel, Elmira, N. Y., Oct. 10-12; Canadian Section, King Edward Hotel, Toronto, Ontario, Canada, Oct. 21-23.

**Electrical Progress Show**—Convention Hall, Philadelphia, Pa., September 27-29.

**National Electronics Conference**—Hotel Sherman, Chicago, Ill., October 3-5.

**International Association of Electrical Leagues**—King Edward Hotel, Toronto, Can., October 5-8.

**National Electrical Industries Show**—69th Regiment Armory, New York City, October 11-14.

**N. J. Council of Electrical Leagues**—19th convention, Atlantic City, N. J., October 14-15.

**National Electrical Contractors Association**—Annual convention Waldorf-Astoria, New York City, October 31-November 4.

**Fifth Industrial Electric Exposition**—Hotel Wm. Penn, Pittsburgh, Pa., November 1-3.

**National Electrical Manufacturers Assn.**—Annual meeting Traymore Hotel, Atlantic City, N. J., November 14-18.

**National Rural Electric Cooperative Assn.**—St. Louis, Mo., January 23-26, 1956.

**American Institute of Electrical Engineers**—Winter general meeting, Hotel Statler, New York, N. Y., January 30-February 3.

**Independent Electrical Contractors Assn., Inc.**—Annual dinner and dance, Hotel Biltmore, New York, N. Y., February 11.

**National Electrical Manufacturers Assn.**—Edgewater Beach Hotel, Chicago, Ill., March 12-16.


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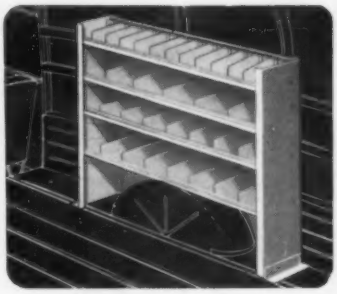

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# Among the Manufacturers

## Headquarters Announcements

Graybar Electric Co., Inc., New York, N. Y.—E. E. Martin, member of the board of directors.

Thomas Industries, Inc., Louisville, Ky.—T. R. Fuller, sales manager of Moe Light and Star Light Divisions; J. L. Parentice holds same position with the Electric Sprayit and the Wright Power Saw and Tool Divisions.

Thomas & Betts Co., Elizabeth, N. J.—N. J. MacDonald, president; Robert Thomas, Jr., general vice president; E. C. Hewitt, vice president in charge of sales.

Progress Mfg. Co., Inc., Philadelphia, Pa.—Ruben Rosen, chairman of the board; Maurice M. Rosen, president.

D. W. Onan & Sons Inc., Minneapolis, Minn.—Hiram Hascall, vice president in charge of sales; J. C. Hoiby, vice president of engineering.

General Electric Co., Lynn, Mass.—J. T. Bailey, general manager of the outdoor lighting dept.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—The General Machinery Division has been renamed the Industries Group. Vice president J. L. Singleton will head the group and J. W. McMullen will be vice president of the power equipment division of the group.

Westinghouse Electric Corp., Pittsburgh, Pa.—R. P. Wagner, sales manager of the transformer division; L. N. Goodell, manager of the Bryant Electric Co., a subsidiary.

Electric Storage Battery Co., Philadelphia, Pa.—Warren Ingersoll, assistant to the president.

Rome Cable Corp., Rome, N. Y.—Glenn Koger, vice president.

Permacel Tape Corp., New Brunswick, N. J.—G. A. Fitzgerald, vice president.

## Regional Appointments

### NEW ENGLAND

General Electric Co., Distribution Assemblies Dept.: H. M. Norton, supervisor of commercial service at Plainville, Conn. plant.

Joy Manufacturing Co.: Donald L. Archibald, district sales manager with headquarters in Boston.

R. E. Uptegraff Mfg. Co.: W. W. Jackson, sales representative for Conn. and western Mass.; Benson, Funk & Associates of Newton, Mass. are representatives for the rest of New England.

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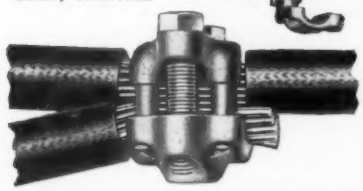

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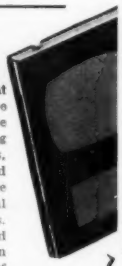

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Litecraft Manufacturing Corp.: Bert Berend, district sales manager for metropolitan New York.

General Electric Co.: Leonard M. Bush, Weathertron representative for New England and Middle Atlantic states: A. J. D. Helwig, water cooler representative for the same area.

Reliance Electric & Engineering Co.: R. W. Palmer, sales engineer, Pittsburgh, Pa.

R. E. Uptegraff Mfg. Co.: Moreland Engineering & Sales Co., York, Pa., are representatives for central Pennsylvania.

### SOUTH ATLANTIC

Universal Motor Co.: C. W. Bringman, Orlando, Fla., direct factory representative for Florida and Georgia.

R. E. Uptegraff Mfg. Co.: Griffin and Griffin, Atlanta, to handle sales in Georgia; Commercial Engineering Co., D. C. are new representatives for the District of Columbia and Maryland.

General Electric Co.: F. J. O'Connor, supervisor of product service for Air Conditioning Div. in the Carolinas; B. S. Bernard, field representative of same division in Washington, D. C.; A. M. Raney, Jr., Weathertron representative for Virginia, North Carolina and District of Columbia is located in Richmond.

### EAST CENTRAL

Beaver Pipe Tools, Inc.: Ned Dengler, district sales manager for southern Ohio, Indiana, West Virginia and Kentucky; offices in Fremont, Ohio.

Accurate Mfg. Co.: A. J. Riopelle, representative in Michigan and Toledo, Ohio.

Jefferson Electric Co.: H. A. Wallis, midwest district sales manager.

Line Material Co.: R. E. Norman of Canton, Ohio office, now sales engineer for central Ohio and West Virginia.

Roller-Smith Corp.: J. G. Pettyjohn Co., Knoxville, Tennessee district sales representatives for Electrical Switchgear Div.

General Electric Co.: M. R. Ayers, representative for Commercial and Industrial Air Conditioning Dept. in Tennessee, Alabama, Mississippi and New Orleans with offices in Memphis.

Reliance Electric & Engineering Co.: Three sales engineers—R. C. Marchant, Rockford, Ill.; T. J. Lisy, Chicago; G. A. Jakes, Toledo, Ohio.


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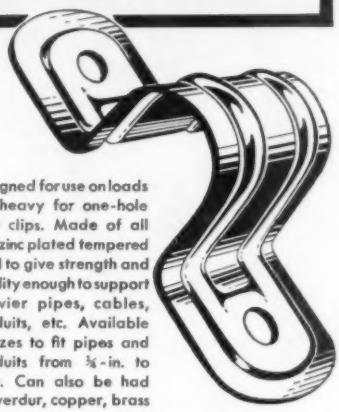

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Graybar Electric Co., Inc.: L. A. Peterson, branch Mgr. at Jackson, Miss.; B. R. Lind, branch Mgr. at Madison, Wis.

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Line Material Co.: Ray H. Draeger, sales application engineer at Milwaukee, Wis. office.

Union Metal Mfg. Co.: G. C. Buchanan, district representative for Texas and Oklahoma; A. W. Crary will cover Kansas and parts of Arkansas, Oklahoma and Missouri.

John A. Roebling's Sons Corp.: C. E. Meluney, Jr., Houston, Texas district sales manager.

Westinghouse Electric Corp.: Burt E. Burke, manager of North Texas district.

Graybar Electric Co.: J. T. Kinney, district operating manager at Houston, Texas; A. N. Saxon, branch manager, Corpus Christi, Texas.

R. E. Uptegraff Mfg. Co.: Eads Co., Houston, sales representative for southern Texas and four Louisiana counties.

Sylvania Electric Products Inc.: Sumner Harris, lighting division salesman supervisor for southern Texas office in Houston.

Allis-Chalmers Mfg. Co.: R. H. Godeke, manager of new general machinery division office in Corpus Christi, Texas.

Graybar Electric Co.: V. P. Flynn, manager of new branch at 206 W. 11th St., Lake Charles, La.

**WEST**

Kerite Co.: Robert A. Young, Pacific Coast manager.

Electric Controller & Mfg. Co.: John L. King, manager of new office at 530 El Camino Real, San Carlos, Calif.

Jefferson Transformer Co.: Jerald D. Huggins, senior salesman for the San Francisco district sales office.

Jefferson Electric Co.: Lyons O. Dugan, sales manager for western district, offices in Los Angeles.

General Electric Co.: Herman Van Nelson, Commercial and Industrial Air Conditioning Dept. representative for Montana, Utah, Idaho, Colorado, Washington and Oregon, headquarters in Salt Lake City.

Standard Transformer Co.: John H. Ormond, Oakland, Calif., is representative for northern California, southern Oregon and northern Nevada.

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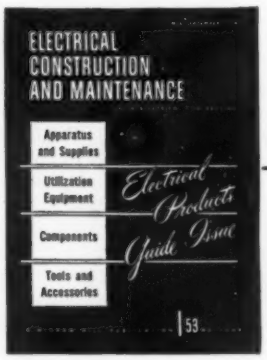


## • These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

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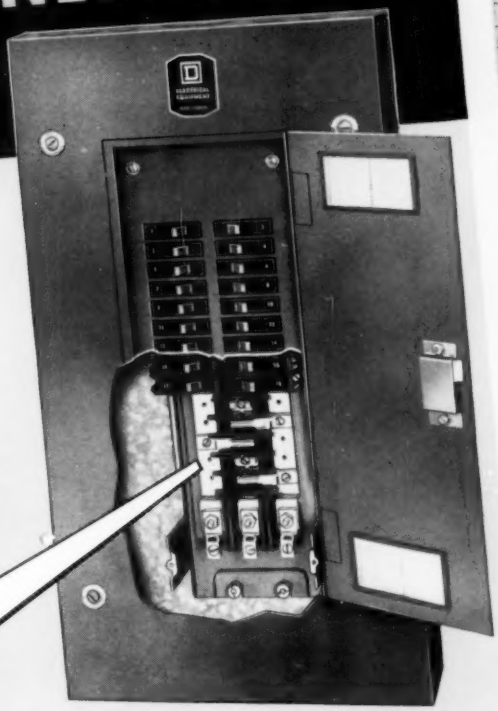

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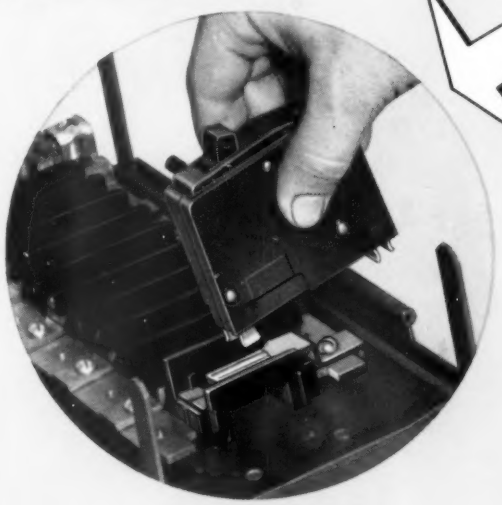

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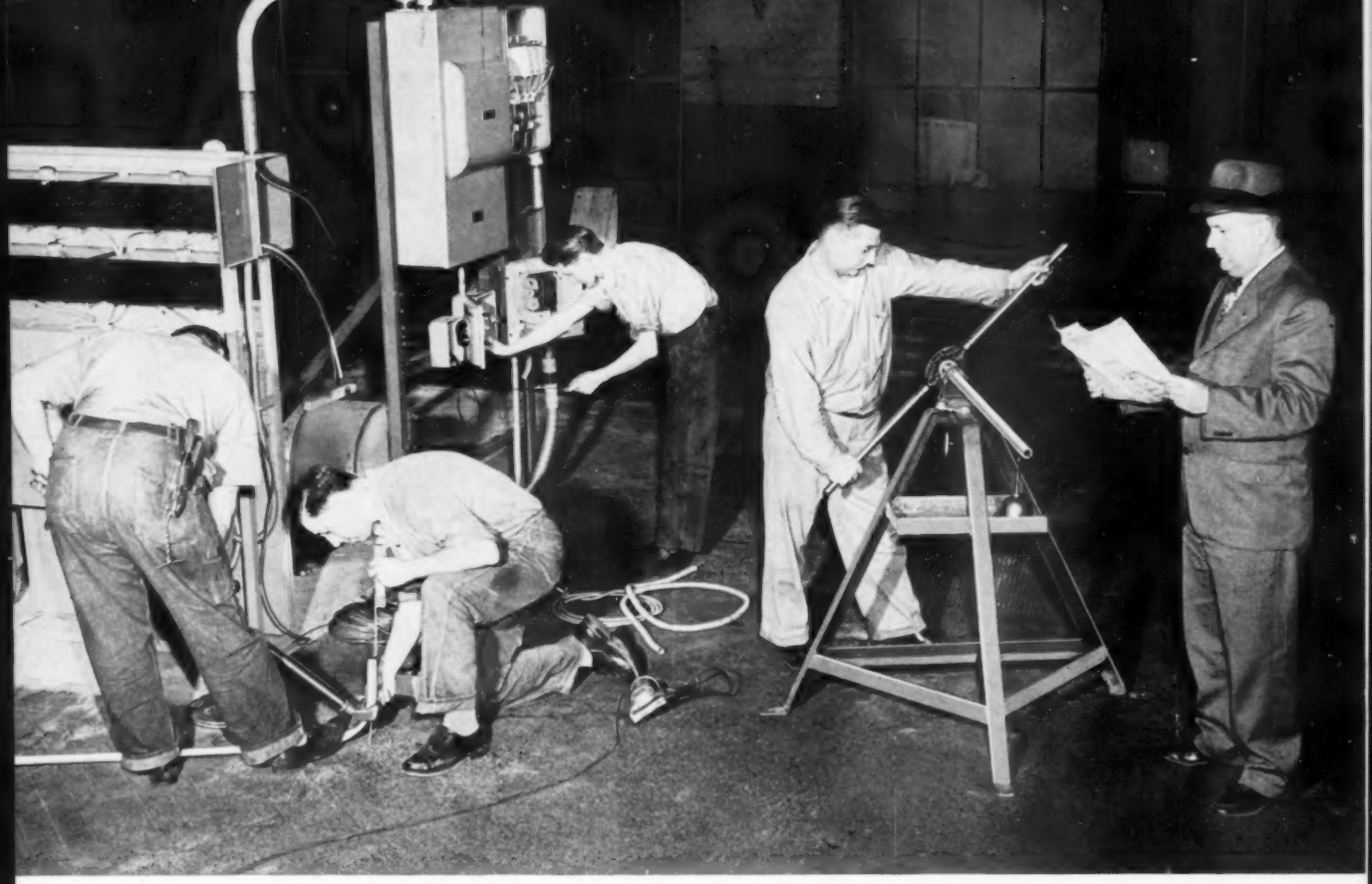
- Compact design—¾" width for each pole conserves valuable space.
- Exclusive **SWINGRIP** mounting provides easier installation, automatic alignment, positive contact with bus bars.

**ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS**

**SQUARE D COMPANY**



# They know G-E White rigid conduit installs easily... resists corrosion

Ask the man who installs rigid conduit and you'll learn why he prefers G-E White. Contractors, too, are finding that G-E White adds a substantial efficiency factor to their installations. It bends easier and threads easier than old-style conduit because galvanizing by metallizing eliminates processes which cause most conduit to harden. Wires pull more easily because the new organic coating on the inside contains a special anti-friction compound.

### . . . and it offers outstanding corrosion-resistant advantages

G-E White rigid steel conduit stands up so well against corrosion, it provides assurance that the job you do today is planned for the future as well. G-E White is zinc-galvanized by metallizing, a process which bonds a uniform coating of pure zinc to the entire outside surface of the conduit, including threads. The interior surface is protected by a special organic coating. Exacting tests prove that the new G-E White offers improved resistance to corrosion from smoke, heat, humidity, acid fumes, alkalies, and salt atmosphere—both inside and out. The C-553 organic coating over the zinc retards white rust and gives extra protection against rough handling.

G-E White is one of many General Electric products designed to help electrical contractors in meeting the challenge of staying one jump ahead of tomorrow's electrical needs while keeping within today's economic limitations. For more information see your G-E Construction Materials distributor or write Section C55-718, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

*Progress Is Our Most Important Product*

GENERAL ELECTRIC